2008 APS April Meeting and HEDP/HEDLA Meeting
St. Louis, Missouri
http://www.aps.org/meetings/april/index.cfm
Friday, April 11, 2008 8:30AM - 11:15AM
Session 1HE HEDP HEDLA: Stellar Explosions, Turbulence and Instabilities
Hyatt Regency St. Louis Riverfront (formerly Adam039:s Mark Hotel), Promenade F

8:30AM 1HE.00001 HED physics frontiers on OMEGA/OMEGA EP1
D.D. MEYERHOFER, Laboratory for Laser Energetics, University of Rochester, Rochester, USA — The 60 beam, 30 kJ, OMEGA laser facility has been operating at the University of Rochester for more than a decade. The OMEGA EP laser facility adjacent to it will be completed in Q3FY08. OMEGA EP will consist of four beamlines with NIF-like architecture. Each of the beams will ultimately produce 10 ns 6.5 kJ energy ultraviolet pulses directed into the EP target chamber. Two of the beamlines will also operate as high energy petawatt (HEPW) lasers, with up to 2.6 kJ each in 10 ps IR pulses. The HEPW beams can be injected into either the EP chamber or the existing OMEGA target chamber for integrated experiments. This talk will describe the OMEGA EP project status, HED physics possibilities using the combined system, and opportunities for external user access. The full OMEGA laser system (original 60 beam OMEGA and OMEGA EP) will allow unprecedented opportunities for HED sciences. These include backlighting of ICF implosions and integrated Fast Ignition Experiments in the OMEGA target chamber. The configuration flexibility of the OMEGA EP target area, will allow a wide variety of HED physics research, with the possibility of mixing and matching short and long pulse laser beams. Research areas will include episodic jets, the use of up to 40 ns long drive pulses for Equation of State measurements, short pulse, high intensity backlighting of otherwise opaque materials, and the possibility of creating an electron-plasmon plasma The ongoing OMEGA EP Use Planning process will be described.

1This work was supported by the U.S. D.O.E Office of Inertial Confinement Fusion under Cooperative Agreement No. DE-FC52-08NA28302.

8:55AM 1HE.00002 Stellar convection and turbulence1
HERBERT J. MUTHSAM, Faculty of Mathematics, University of Vienna, Austria — We give an overview on recent research about turbulent stellar convection. In addition to analytical models there are in particular numerical models being developed at an increasing rate. Such simulations presently consider already rather varied contexts in stellar physics, starting with classical aspects such as solar granulation, to model large parts of convective envelopes of normal stars or stellar convective cores. They address now even the less classical situation where convection in shells is more directly connected to nuclear burning such as oxygen burning in late stages of the evolution of massive stars. We describe the convective flow by means of analytic models, viz. the general structure of the convective flows, the nature of the turbulent field and overshooting. We will also address model verification and open questions.

1Support from the Austrian Science Foundation is gratefully acknowledged (grants P17024, P18224)

9:20AM 1HE.00003 Type II Supernovae1
TOMASZ PLEWA, School of Computational Science, Florida State University — We give an overview of the hydrodynamics of core collapse supernova explosions according to the results of recent two and three-dimensional numerical simulations. Emphasis is placed on the various hydrodynamic instabilities that occur during both the early and advanced stages of the explosion, and the importance of these instabilities for the interpretation of supernova observations, like spectra, light curves, polarimeter, and inferred pulsar recoil. The Type II supernova SN 1987A in the Large Magellanic Cloud is used as a case study to illustrate these points.

9:45AM 1HE.00004 Laboratory blast wave driven instabilities
CAROLYN KURANZ, University of Michigan — This presentation discusses experiments well-scaled to the blast wave driven instabilities during the explosion phase of SN1987A. Blast waves occur following a sudden, finite release of energy, and consist of a shock front followed by a rarefaction wave. When a blast wave crosses an interface with a decrease in density, hydrodynamic instabilities will develop. These experiments include target materials scaled in density to the He/H layer in SN1987A. About 5 kJ of laser energy from the Omega Laser facility irradiates a 150 µm plastic layer that is followed by a low density foam layer. A blast wave structure similar to those in supernovae, is created in the plastic layer. The blast wave crosses a perturbed interface, which produces nonlinear, unstable growth dominated by the Rayleigh-Taylor (RT) instability. Recent experiments have been performed using complex initial conditions featuring a three-dimensional interface structure with a wavelength of 71 µm in two orthogonal directions, at times supplemented by an additional sinusoidal mode of 212 µm or 424 µm. We have detected the interface structure under these conditions, using dual orthogonal radiographs on some shots, and will show some of the resulting data. Recent advancements in our x-ray backlighting techniques have greatly improved the resolution of our x-ray radiographic images. Under certain conditions, the improved images show some mass extending beyond the RT spike and penetrating further than previously observed. Current simulations do not show this phenomenon. This presentation will discuss the amount of mass in these spike extensions as well as the error analysis of this calculation. Future experiments will also be discussed. They will be focusing on realistic initial conditions based on 3D stellar evolution models. This research was sponsored by the Stewardship Science Academic Alliances Program through DOE Research Grants DE-FG52-07NA28058, DE-FG52-04NA00064, and other grants and contracts.

10:10AM 1HE.00005 Theory and simulation of astrophysical explosions and turbulence
AARON MILES, Lawrence Livermore National Laboratory — Supernova explosions are among the most dramatic in the universe. Type II supernovae follow the core collapse of a massive star, while Type Ia supernovae are typically believed to be thermonuclear explosions of carbon-oxygen white dwarfs that have accreted enough material to initiate carbon burning. In both cases, the explosion dynamics are complicated by hydrodynamic instabilities that make spherical symmetry impossible. Much of the work that is done on hydrodynamic advection in ShanDM model is on the fundamental instability problems of classical Rayleigh-Taylor (RT) and steady-shock Richtmyer-Meshkov (RM), and, on the other hand, on complex (often multiphysics) computational and experimental systems. These include numerical simulations of supernovae and laser-driven laboratory experiments that invoke Euler scaling to make connections to their much larger astrophysical counterparts. In this talk, we consider what additional insight is to be gained from considering a third fundamental instability problem that is more relevant than either RT or RM in isolation and somewhat less complex than the full system. Namely, we consider an idealized blast-wave-driven problem in which a localized source drives a divergent Taylor-Sedov blast wave that in turn drives a perturbed interface between heavier and lighter gamma-law fluids. Within this context, we use numerical simulations and simplified analytic models to consider the effect of the initial perturbation spectrum in determining the late-time asymptotic state of the mixing zone, the interaction of multiple unstable interfaces relevant to core-collapse supernovae, and the proximity of the forward shock to the developing instability. Finally, we discuss how laser-driven laboratory experiments might be used to help resolve some of the most unanswered questions in supernova explosion hydrodynamics.

10:35AM 1HE.00006 Nonlinear evolution of hydrodynamic instabilities from multimode initial perturbation
DOV SHVARTS, Nuclear Research Center Negev and Ben-Gurion U. of the Negev, ISRAEL and Laboratory for Laser Energetics, U.of Rochester, USA — The RT and RM hydrodynamic instabilities are subjects of intensive experimental and theoretical research because of their critical importance in inertial confinement fusion and astrophysics research. The nonlinear evolutions of those instabilities in 3D, from an initial multimode perturbation, were study. The bubble-competition and the mode-coupling models, developed to describe the nonlinear evolution of the instability from a multimode initial perturbation, as well as full 3D numerical simulations. Collaborators: O. Sadot, V. Smalyuk, Y. Elbaz, E. Leionov, A. Formozov, G. Malamud, N. Wygoda, A. L. Levin, G. Ben-Dor, J. A. Delettrez, D. D. Meyerhofer, T. C. Sangster, R. Betti, V. N. Goncharov.
11:15AM 2HE.00001 Photoionized Plasma and Opacity Experiments on the Z Machine, JAMES BAILEY, Sandia National Laboratories — Laboratory experiments at Z use high energy density to create plasma conditions similar to extreme astrophysical environments, including stellar interiors and accretion powered objects. The importance of radiation unifies these topics, even though the plasmas involved are very different. Understanding stellar interiors requires knowledge of radiation transport in dense, hot, collision-dominated plasma. A Z x-ray source was used to measure iron plasma transmission at 156 eV electron temperature, 2x higher than in prior work. The data provide the first experimental tests of absorption features critical for stellar interior opacity models and may provide insight into whether the present discrepancy between solar models and helioseismology originates in opacity model deficiencies or in some other aspect of the solar model. In contrast, accretion physics requires interpretation of x-ray spectra from lower density photoionization-dominated plasma. Exploiting astrophysical spectra requires a spectral model that connects the observations with a model that describes the overall picture of the astrophysical object. However, photoionized plasma spectral models are largely untested. Z-pinch radiation was used to create photoionized iron and neon plasmas with photoionization parameter 5-25 erg cm /s. Comparisons with the data improve x-ray photoionization models and promote more accurate interpretation of spectra acquired with astrophysical observatories. The prospects for new experiments at the higher radiation powers provided by the recently upgraded Z facility will be described.6 In collaboration with scientists from CEA, LANL, LLNL, Oxford, Prism, Queens University, Swarthmore College, U. Nevada Reno, and Sandia the Z-pinch is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

11:40AM 2HE.00002 Current Challenges of Astrophysical Photoionized Plasmas, MICHAEL WIT-THOEFT, NASA/GSFC — Photoionization and photoexcitation has been known to be important in astrophysical plasmas since the early study of emission line nebulae, and the study of optical and UV emission lines is a classical subject. Recently, this has broadened to include emission in other wavelength bands. In the X-ray band, Chandra and XMM-Newton have revealed rich spectra from active galaxies and compact binaries, and this has motivated new efforts at modeling these plasmas. This has led to insights about a component of the gas in these systems which had been previously unknown, observationally, and which has implications for our understanding of the global mass budget. In this talk I will review the observational data on these plasmas, and discuss some recent results on modeling.

12:05PM 2HE.00003 Astrophysics of Accretion onto Compact Objects, JOHN HAWLEY, University of Virginia — The most energetic phenomena in the universe are systems powered by gravity through accretion. For compact stars such as white dwarfs, neutron stars, and especially black holes, the energy released per unit mass accreted can significantly exceed that released by nuclear reactions. Over the last half century a growing body of observations has revealed a plethora of environments in which accretion plays a significant or even dominant role. Our theoretical understanding of accretion disk systems has not kept pace. Until recently theory has been based primarily on a one-dimensional time-steady model consisting of an optically thick, vertically-thin, Keplerian disk with an unknown, parameterized internal stress. While these analytic models have served us well to understand many properties of a wide variety of accretion systems, their limitations are now well-known, and the observation data demand moving beyond this standard. Space- and ground-based observations are providing increasingly detailed evidence that accretion systems are dynamic. For example, the spectral energy distribution and luminosity for sources such as X-ray binaries and AGN are strongly variable, often with substantial amplitudes. The timescales for variability are rapid, often comparable to the dynamical times associated with orbits near the central black hole. This variability must arise not from secular changes in the accretion rate (the only process accessible to time-stationary analytic disk models) but from processes that occur within the disk. Numerical simulations provide a way to investigate the dynamics of accretion flows directly with far fewer limitations compared to analytic models. Because magnetic fields are fundamentally important for jets and disks, and because we now know that magnetic turbulence accounts for the internal stress, the governing equations are those of compressible magnetohydrodynamics (MHD). Accretion disk dynamics can thus be investigated using three-dimensional MHD simulation codes that employ both global and local computational domains. Although it is not yet possible to do fully global time-dependent radiation transport in disk models, the observational implications of these simulations can be investigated using simple emission and absorption models coupled with relativistic ray tracing. The time and length-scales involved make such simulations challenging, but even the first results are intriguing. They have revealed details about time-dependent properties of disks, magnetic disk dynamo, jet launching mechanisms, and the dynamical properties of systems other than the standard thin disk. As the capabilities of computational hardware increase, and the development of advanced numerical codes continues, our theoretical understanding of accretion physics will substantially increase.

12:30PM 2HE.00004 Radiation transfer experiments using high-power lasers, STEVEN ROSE, Imperial College London — Experiments using high-power lasers that investigate radiation transfer have been undertaken for many years. We shall summarise different experimental approaches that have been used and consider what has been learned from those experiments which include studies of diffusive energy flow and line radiation transfer both in static plasmas and where there is a large plasma velocity gradient. We shall conclude with a discussion of recent theoretical work studying the effect of plasma geometry on line radiation transfer, together with its application to astrophysical observations and laboratory experiments.

12:55PM 2HE.00005 LUNCH BREAK —

2:25PM 2HE.00006 Experimental and Computational Analysis of Photo-ionized Non-LTE Plasma Produced by Intense Laser, HIDEAKI TAKABE, Institute of Laser Engineering, Osaka University — Two types of photoionized plasma experiments have been carried out with Gekko-XII laser in Osaka and Shingang-II laser in Shanghai as joint experiment with China. One is spectroscopic measurement of self emission from nitrogen plasma and the other is absorption by silicon plasma both heated by almost Planckian radiation with Tr = 80 eV in gold cavities heated by lasers. Experimental data are analyzed with two different codes developed in Japan and China. The code coupled with rate equation solver and HULLAC says that the nitrogen gas line emission can be explained when we assume the electron temperature is much lower than Tr and we obtained a good agreement with the electron temperature 20 eV. It is pointed out that this spectrum can be reproduced even if we assume the plasma and radiation is in LTE with Tr = Te = 60 eV. This suggests careful analysis is required in analyzing observational spectra from Universe.

This work has been done as Japan-China Joint Research supported by JSPS, Japan and NSFC, China.
Jets and outflows are ubiquitous among the accretion process in a variety of astrophysical objects. Global three-dimensional (3-D) magnetohydrodynamic (MHD) simulations of accretion flows have revealed the generation of jets by the emergence of a magnetic tower. In other words, the magnetic interaction associated with stars and/or accretion disks is a promising universal mechanism of launching jets. However, photon spectra of accretion flows and jets in some microquasars display some serious problems. When spectrum is dominated by non-thermal emissions, a mildly relativistic steady jet is observed. On the other hand, when spectrum is dominated by thermal emissions, no jet is observed. Remarkably, during a transition from a non-thermal state to a thermal state, a ultra-relativistic transient jet is observed. Therefore, the radiation in a magnetized accretion flow is a key to understand the formation of jets. In this talk, we present 3-D MHD simulations of magnetic tower jets and also 3-D radiation transfer (RT) simulations of magnetic tower jets. The possible connection between the emergence of magnetic tower jets and the evolution of radiation properties will be discussed.
Atmospheric Science, UC Berkeley and Co-Director, Berkeley Institute of the Environment — Physics of the climate system is captured, with varying degrees of success, in climate models used to hindcast paleoclimates and project future climate change. This talk reviews the formulation of climate models, numerical simulations.

processes that operate in essentially similar ways within these varied environments including the transport of momentum, heat and cosmic rays, the stretching exhibited by cosmic plasma phenomena range from those associated with terrestrial auroras to giant clusters of galaxies. There are many fundamental plasma justifications and explaining a growing list of observed phenomena that depend upon collisionless, collective effects is the domain of plasma astrophysics. The scales it as a fluid endowed with a bulk velocity, density, pressure etc despite the fact it is often out of thermodynamic equilibrium. Understanding when this is justified and explaining a growing list of observed phenomena that depend upon collisionless, collective effects is the domain of plasma astrophysics. The scales

— Most of the baryonic matter in the universe exists in an ionized form within stars and the intergalactic medium. For many purposes, it is adequate to treat it as a fluid endowed with a bulk velocity, density, pressure etc despite the fact it is often out of thermodynamic equilibrium. Understanding when this is justified and explaining a growing list of observed phenomena that depend upon collisionless, collective effects is the domain of plasma astrophysics. The scales


1Supported by the U.S. Department of Energy under Contracts Nos. DE-FG02-96ER40963 and DE-AC05-00OR22725
11:21AM B2.00002 Standard Model Signals and New Physics Constraints, ERIK BRUBAKER, University of Chicago — Fermilab’s Tevatron is the energy frontier machine for high energy physics experiments. It remains the best place to observe electroweak scale processes, both those that are expected in the context of the standard model and those arising from as yet undetermined new physics. The two general purpose experiments at the Tevatron, CDF and D0, have now collected and analyzed over 2 fb−1 of data. We use a wide variety of final states to search directly for new particles and interactions, and to look for indirect evidence of new physics. This requires a precise understanding of standard model processes, many of which are interesting in their own right. Some low-rate standard model processes are just coming within reach of experimental observation. In this talk, I will summarize the challenges, analysis techniques, and results from CDF and D0 for a range of topics, including single top production, diboson production, signature-based searches, and constraints on supersymmetric models and other beyond the standard model physics.

11:57AM B2.00003 Searching for the Higgs at the Tevatron – Present and Future1, BRIAN WINTER, The Ohio State University — The Tevatron has delivered more than 3.5 inverse femtobarns of proton-antiproton collisions to the DZero and CDF experiments. Using a wide variety of approaches, the two collaborations are analyzing these data to search for the Higgs boson. The search includes two different production mechanisms for the Higgs boson. In the low mass range, rh<~135 GeV/c², the analyses search for the Higgs boson produced in association with either a W or Z boson. Identifying the vector boson, typically through one of its leptonic decays, greatly reduces background sources. However, to obtain the best sensitivity, these analyses must also rely on the fact that a Higgs boson in this mass range is expected to decay primarily to a bottom-antibottom quark pair. In the higher mass range, 130 < rh < 200 GeV/c², the analyses search for the Higgs Boson produce singly and decaying to a pair of vector bosons, primarily WW. This talk will review the analysis techniques such as event selection, b-quark tagging, advanced analysis approaches, and the unique challenges of the Tevatron Higgs boson search. The talk will present the current production cross section limits, including the combined limits between different search channels and between CDF and DZero results. Finally, it will discuss the prospects for future limits based on projected data sample sizes and anticipated improvement to the search techniques.

1Presenting for the CDF and DZero Collaborations

Saturday, April 12, 2008 10:45AM - 12:33PM –
Session B3 DNP GB: Few Body Nuclear Physics I Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis E

10:45AM B3.00001 Auxiliary Field Diffusion Monte Carlo for nuclei and nuclear matter.1, KEVIN SCHMIDT, Arizona State University — Quantum Monte Carlo methods have become a mainstream tool for understanding many-body quantum systems. The nuclear Hamiltonian with its strong spin-isospin dependence presents some special difficulties. I will describe the Auxiliary Field Diffusion Monte Carlo method which combines diffusion Monte Carlo sampling of the spatial positions of the nucleons along with an auxiliary field breakup that simplifies the sampling of the spin-isospin degrees of freedom. Results for nuclei, nuclear and neutron matter will be shown. The current state of the calculations, the approximations being made, and future prospects will be discussed.

1Supported by NSF Grant PHY-045669

11:21AM B3.00002 Coupled-Cluster Theory for Molecular Structure and Spectra: The Challenges Posed By Molecules and the Coupled-Cluster Solutions1, RODNEY BARTLETT — Coupled-cluster (CC) theory derives from the ansatz that the n-particle wavefunction is |Ψ> = Ψ(k) = Ψ(0)|0>, where T is an excitation operator with |0> some choice of mean-field wavefunction. That is sufficient to obtain energies. But to obtain anything else, we use the CC functional, E<0|T(1+Λ)exp(-T)Hexp(T)|0>, whose left and right hand eigenvectors provide energies and associated density matrices for the treatment of properties in CC theory. The introduction of Λ makes it possible to obtain the ~3N forces associated with N atoms in the same time as the energy itself. This is essential information for indentifying the critical points on a potential energy surface and their associated Hessians, for example, for the prediction of vibrational spectra and or to characterize a saddle point (transition state) for a reaction. A generalization of the functional to ω(k) = <0|L(k) exp(-T)Hexp(T)R(k)|0>, provides excitation energies, ω(k) along with excited state left- and right-hand wavefunctions. Finally, with the response functions obtained from these left- and right-hand eigenfunctions, used in closed form, higher-order properties like NMR coupling constants are obtained. In this way, coupled-cluster theory provides a method that addresses all the properties of interest for molecules and their interactions. This development will be the topic of our contribution. For details please see, R. J. Bartlett and M Musial, “Coupled-cluster theory in quantum chemistry”, Revs. of Modern Phys. 79, 291-352 (2007).

1This work was supported by U.S. Air Force Office of Scientific Research.

11:57AM B3.00003 Beyond the Shell Model: Computing Nuclei with Coupled-Cluster Theory, DAVID DEAN, Oak Ridge National Laboratory — Investigations of rare isotopes in the laboratory are opening the way to understand and clarify the properties of all nuclei and bulk nuclear matter. In this talk I will assess where we stand today in solving the nuclear problem and how future rare isotope facilities will impact our understanding of nuclei. The first part of the nuclear problem concerns our ability to describe complex nuclei using as input the basic interactions among protons and neutrons. Indeed, our community is on the verge of discovering how light nuclear systems are built from nuclear interactions that have their roots in QCD. I will describe this exciting frontier of research through illustrating recent progress in the nuclear implementation of coupled-cluster methods, a quantum many-body technique that enjoys great success in quantum chemistry. Nuclei offer some interesting challenges to coupled-cluster theory and quantum many-body theory generally: first, effective field theory implementations of the nuclear forces indicate the presence of a three-body force. Second, very weakly bound nuclei can best be described utilizing a single-particle basis consisting of bound and continuum states. In both cases, we have developed methods to solve for nuclear properties in these systems. I will also describe the computational requirements for the solution of the nuclear coupled-cluster problem. This research is supported by the U.S. Department of Energy under Contract Number DE-AC05-00OR22725 with UT-Battelle, LLC (Oak Ridge National Laboratory).

Saturday, April 12, 2008 10:45AM - 12:33PM –
Session B4 FEd FPS: How to Communicate Physics to the General Public Using Books and Articles Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade B
10:45AM B4.00001 Writing about, and teaching, physics for non-scientists, ART HOBSON, University of Arkansas — Physicists must communicate their knowledge to the general public because, as the American Association for the Advancement of Science puts it, “without a scientifically literate population, the outlook for a better world is not promising.” I’ll discuss what I’ve learned about writing for non-scientists from my physics textbook for non-science college students, Physics: Concepts and Connections, now in its fourth edition and in use on 130 campuses, and also from my bi-weekly hometown newspaper column. Lessons learned include the process of organizing and writing a textbook, tips for writing effective prose, dos and don’ts when writing for non-scientists, choice of subject matter, being relevant to the needs of non-scientists, and unifying one’s book through the use of such general themes as “the scientific process,” or “energy.” For real-world relevance, I suggest emphasizing physics-related social topics, and modern and contemporary physics. I highly recommend Michael Alley’s book The Craft of Scientific Writing, as well as Strunk and White’s timeless Elements of Style.

11:21AM B4.00002 ABSTRACT WITHDRAWN —

11:57AM B4.00003 Explaining Science to non-Scientists, MICHAEL LEMONICK, Princeton University, TIME Magazine — No abstract available.

Saturday, April 12, 2008 10:45AM - 12:33PM – Session B5 DAP DPF: Dark Matter

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade C

10:45AM B5.00001 New approaches to dark matter and neutrino detection, JOSEPH MILLER, Lick Observatory — With the establishment of the Lick Observatory on Mt. Hamilton in California in 1888 it was immediately established that an observatory located on a relatively high site far from city lights was a far superior location for optical astronomy than the previously common city locations. A few years after its beginning, astronomers at Lick convincingly demonstrated the clear advantage of the reflecting telescope immediately established that an observatory located on a relatively high site far from city lights was a far superior location for optical astronomy than the previously common city locations. A few years after its beginning, astronomers at Lick convincingly demonstrated the clear advantage of the reflecting telescope over the first half of the 20th century the establishment of the Mt. Wilson and Palomar Observatories expanded California’s dominance in optical astronomy. Not only was a reflector achromatic over all wavelengths, but it could be made with a small focal ratio that provided high photographic speed. Furthermore, since light did not pass through the optic and it could be supported from behind, it could easily be made in large sizes. Over the first hundred years of the 20th century the California pioneering advancement in ground-based optical and infrared telescopes current the largest general-purpose optical/infrared telescopes in the world. However, California skies were abandoned in favor of a much superior site in Hawaii.

11:21AM B5.00002 The race to detect WIMP dark matter with liquid noble-based detectors, TOM SHUTT, Case University — The direct search for WIMP dark matter is on the verge of a major increase in sensitivity, in particular due to the advent of detectors based on liquefied noble elements. The best dark matter limits are now from XENON10, a two-phase xenon detector with 5 kg fiducial mass, and a set of larger, next generation experiments based on Ar and Xe are planned or underway. This includes the 300 kg LUX experiment, of which I am a member, and which will operate in the historic Davis cavern in the new SUSEL lab in South Dakota. These technologies and the proposed DUSEL underground laboratory offer an unprecedented opportunity for dark matter searches with sensitive masses up to at least 10 tons. This would provide a nearly complete test of dark matter at the weak scale.

11:57AM B5.00003 Indirect Detection of Dark Matter in a New Experimental Era, ELLIOTT BLOOM, KIPAC-SLAC, Stanford University — The discovery of the nature of dark matter has been a major goal of Particle Astrophysics over the past two decades. In order to establish the existence of particle dark matter one needs (in no particular order) to detect dark matter as particles in the galaxy and the universe, and detect the identical particles in controlled environments at particle accelerators. Indirect detection of dark matter is the method used to detect dark matter particles via the decay products of their annihilation or decay in situ in the galaxy and the universe. The decay products most commonly used as dark matter messengers in current searches are photons, electrons, positrons, protons, antiprotons, and neutrinos. Indirect detection methods use both information about the particle physics model needed to calculate annihilation or decay rates, and the source structure of the dark matter under consideration, e.g., the density distribution of dark matter halo of the galaxy. In addition, depending on which particle messenger is used, astrophysical backgrounds can be more or less a source of confusion to a potential signal and need to be well understood via subsidiary measurement before reliable limits can be reported or a discovery claimed. A new experimental era promising much better limits or (hopefully) a discovery will soon begin. New indirect detections experiments involving space based satellites (the Large Area Space Telescope, GLAST is one of my favorites), ground based gamma ray telescopes, and neutrino telescopes have recently started operation or are coming on line this year. In addition, improved underground based direct detection experiments and of course the LHC are also beginning operation latter this year. In my talk I will review the current status of indirect detection experiments, and speculate on what the dramatic improvement of experimental capability expected this year might bring.

1 This work is supported by U.S. Department of Energy contract number DE-AC02-76SF00515

Saturday, April 12, 2008 10:45AM - 12:33PM – Session B6 FHP DAP: Triumphs of 20th Century Astrophysics I: Observatories and Telescopes

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade D

10:45AM B6.00001 Lick Observatory, California, and 20th Century Leadership in Optical Astronomy, JOSEPH MILLER, Lick Observatory — With the establishment of the Lick Observatory on Mt. Hamilton in California in 1888 it was immediately established that an observatory located on a relatively high site far from city lights was a far superior location for optical astronomy than the previously common city locations. A few years after its beginning, astronomers at Lick convincingly demonstrated the clear advantage of the reflecting telescope for astronomical research. Not only was a reflector achromatic over all wavelengths, but it could be made with a small focal ratio that provided high photographic speed. Furthermore, since light did not pass through the optic and it could be supported from behind, it could easily be made in large sizes. Over the first half of the 20th century the establishment of the Mt. Wilson and Palomar Observatories expanded California’s dominance in optical astronomy. Also with the new larger telescopes came major progress in the design of focal plane instrumentation that allowed these telescopes to be superb tools for astrophysical research. The California observatories of the 20th century were largely independent of Federal funding for operations. Their facilities were maintained and mostly used by their permanent staffs. This led to a style of doing forefront research that was highly effective, as both long-term survey-type programs and more speculative investigations with less-clear payoffs at the outset could be supported. Also the, the close connection of the scientists doing the research to the development of the telescopes and instruments they used for their research confered advantages. At present, this style of doing astronomical observational research is a relatively small fraction of all this kind of research. At the end of the 20th century the California pioneering advancement in ground-based optical astronomy was repeated with the creation of the Keck Observatory. A joint project of the University of California and the California Institute of Technology, this observatory features two 10-m telescopes, current the largest general-purpose optical/infrared telescopes in the world. However, California skies were abandoned in favor of a much superior site in Hawaii.
11:21 AM B6.00002 The Scientific Achievements of the Hubble Space Telescope. MARIO LIVIO, Space Telescope Science Institute — I will review the most important scientific achievements of the Hubble Space Telescope. I will cover topics ranging from Dark Energy to Extrasolar Planets. I will also show some of the latest breathtaking images taken by the telescope, and explain briefly how the upcoming servicing mission will enhance Hubble’s capabilities.

11:57 AM B6.00003 Large Telescopes and Instrumentation of the Future. ELIZABETH BARTON, Center for Cosmology, University of California, Irvine — An exciting array of new ground-based facilities may lie in our future. Upcoming or planned wide-field projects will parameterize dark energy, map dark matter, and pinpoint the baryon acoustic oscillations. Large-aperture, narrower-field facilities will trace the formation of galaxies and black holes from extremely early epochs in the universe and unveil the mysteries of planet formation. I will describe some of the plans and the key science cases for the next generation of optical and infrared ground-based facilities.

Saturday, April 12, 2008 10:45 AM - 12:33 PM — Session B7 GGR: The Quantum Nature of Gravitational Singularities

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Rose Garden

10:45 AM B7.00001 The Nature of Classical Singularities. BEVERLY K. BERGER, National Science Foundation — Almost 40 years ago, Penrose and Hawking proved that, for reasonable matter, some type of singular behavior would arise if gravitational fields were to become sufficiently strong. The nature of the singular behavior was not specified and examples exhibiting a wide variety of pathologies are known. Shortly thereafter, Belinskii, Lifshitz, and Khalatnikov (BK1) conjectured that singularities arising from generic gravitational collapse would be spacelike and local (in the sense that spatial derivatives would not be dynamically important so that each spatial point would evolve as a separate universe). The status of our knowledge about singularities in classical general relativity, both at a rigorous mathematical level and through numerical simulations, will be reviewed.

11:21 AM B7.00002 Singularity Resolution in Loop Quantum Gravity. ABHAY ASHTEKAR, IGC, Penn State — By now there are several examples in loop quantum gravity in which effects of quantum geometry became important, dominate the Planck regime and resolve classical singularities. The resulting quantum space-times are typically significantly larger than the original classical space-times. In simple examples, the physics of these quantum extensions has shed considerable light on issues such as the quantum nature of the big-bang and information loss puzzle. I will present a few examples to illustrate this growing area.

11:57 AM B7.00003 Singularity resolution in string theory. GARY HOROWITZ, UC Santa Barbara — I will give an overview of what string theory can say about the singularities of general relativity. While we do not yet have a complete answer, progress has been made in two different directions. Even perturbatively, string theory resolves some singularities since strings sense spacetime differently than point particles. A nonperturbative formulation of string theory is provided by a gauge/gravity duality. This provides a way to map the problem of spacetime singularities into a problem in a nongravitational field theory. I will give examples of both approaches, and describe the remaining open problems.

Saturday, April 12, 2008 10:45 AM - 12:33 PM — Session B8 DAP: Neutrino Astronomy

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade A

10:45 AM B8.00001 Introducing ANITA. STEPHEN HOOVER, UCLA, ANITA COLLABORATION — The Antarctic Impulsive Transient Antenna (ANITA) is a long duration balloon experiment built to detect radio Cherenkov emissions from > 3 EeV cosmogenic neutrinos that interact in the Antarctic ice sheet. A known source of these neutrinos is provided by the GZK effect, in which ultra-high energy (> 10 EeV) cosmic rays interact with the cosmic microwave background. The instrument uses 32 quad-ridged horn antennas to observe the ice from an altitude of 120,000 feet. ANITA successfully completed its first flight in winter 2006-2007, spending a total of 36 days in the air. Data from this flight will be shown.

10:57 AM B8.00002 Simulating surface roughness and its effects on electromagnetic waves scattering. KAMLESH DOOKAYKA, University of California, Irvine — Surface roughness affects electromagnetic wave scattering in that there is transmission for light incident beyond the critical angle within the denser medium. Simulation studies are first used to corroborate experimental observation of such transmittance in the case of optical light, and are then applied to a regime corresponding to radio wave transmission through a rough air-ice interface. This is especially relevant for the ANITA experiment which detects radio Cherenkov emissions from within the Antarctic ice sheet.

11:09 AM B8.00003 Using ANITA to Measure Ultra High Energy Neutrino-Nucleon Cross Section. FENFANG WU, UC, ANITA COLLABORATION — The balloon-borne ANtarctica Impulsive Transient Antenna (ANITA) was successfully launched on December 15th, 2006 and remained in the air for about 35 days. It was designed to detect ultra high energy (greater than 3 EeV) neutrinos by detecting the Askaryan pulses from the neutrino-nucleon interactions in the ice. The usual detection scenario involves nearly horizontal neutrinos interacting in the bulk ice of the Antarctic ice sheet to produce detectable radio signatures. There is an alternative detection channel from the interactions within the coastal ice shelves. Recent studies of the Ross Ice Shelf confirm earlier work that indicated that most of the ice-water boundary beneath the shelf behaves like a very good mirror at radio frequencies. This property and the relatively long field attenuation length create the opportunity to observe reflected radio pulses from the bottom. The interaction rate from the relatively thin ice shelves is more sensitive to the neutrino cross-section than the rate from the bulk ice. With sufficient statistics, the cross-section can be measured by comparing the rate of neutrino interactions in the ice sheet to the ice shelf. The method and its advantages and limitations will be presented.

11:21 AM B8.00004 The Outlook for ANITA-II. ABIGAIL GOODHUE, University of California Los Angeles, ANITA COLLABORATION — The Antarctic Impulsive Transient Antenna (ANITA) is a long duration balloon experiment built for the radio detection of ultra high energy cosmogenic neutrinos that interact in the Antarctic ice sheet. After the success of the first flight of ANITA in the 2006-2007 Antarctic season, we are preparing for ANITA-II, an upgraded instrument and payload that will fly in the 2008-2009 season. Planned improvements include new front-end signal chain components, new trigger logic, and the addition of eight drop-down antennas to the payload. These upgrades together with a favorable flight path would increase the sensitivity of ANITA by several factors.
11:33AM B8.00005 Investigation of irreducible backgrounds in the Radio Ice Cerenkov Experiment, MARK STOCKHAM, University of Kansas, RICE COLLABORATION — Previously considered background sources are summarized and classified in a noise taxonomy. New examined sources are presented and are likewise classified. Such backgrounds may be important to the next-generation radio neutrino experiments at the South Pole.

11:45AM B8.00006 Electromagnetic shower reconstruction in deep sea neutrino telescopes1, SALVATORE MANGANO, NIKHEF University of Amsterdam (Netherlands), VINCENZO FLAMINIO, Pisa University and INFN-Pisa (Italy) — The ANTARES neutrino telescope is presently being built in the Mediterranean Sea, 40 km off the French coast. The complete detector will be a 3-dimensional grid of 12 lines equipped with 900 photomultipliers, installed at a depth of 2500m. The primary aim of the experiment is the detection of high energy cosmic muon neutrinos, which are identified by the muons that are produced in charged current interactions. These muons are detected by the measurement of the Cherenkov light which they emit when traversing the detector. In addition, above several hundred GeV the muon energy loss is dominated by pair production, bremsstrahlung, and photonuclear interactions. These three effects are referred to as electromagnetic showers. A method to reconstruct the electromagnetic showers produced by the muons is presented, which has been applied to the data. For the first time the multiplicity of showers produced in deep sea neutrino telescopes has been determined and compared to simulations.

1On behalf of the ANTARES collaboration

11:57AM B8.00007 An upper limit on the electron-neutrino flux from the HiRes detector, LAUREN SCOTT, Rutgers, the State University of New Jersey, HIGH RESOLUTION FLY'S EYE COLLABORATION — Air-fluorescence detectors such as the High Resolution Fly’s Eye (HiRes) detector are very sensitive to upward-going, Earth-skimming ultrahigh energy electron-neutrino-induced showers. This is due to the relatively large interaction cross sections of these high-energy neutrinos and to the Landau-Pomeranchuk-Migdal (LPM) effect. The LPM effect causes a significant decrease in the cross sections for bremsstrahlung and pair production, allowing charged-current electron-neutrino-induced showers occurring deep in the Earth’s crust to be detectable as they exit the Earth into the atmosphere. A search for upward-going neutrino-induced showers in the HiRes-II monocular dataset has yielded a null result. From an LPM calculation of the energy spectrum of charged particles as a function of primary energy and depth for electron-induced showers in rock, we calculate the shape of the resulting profile of these showers in air. We describe a full detector Monte Carlo simulation to determine the detector response to upward-going electron-neutrino-induced cascades and present an upper limit on the flux of electron-neutrinos.

12:09PM B8.00008 Tau Neutrino Limit on Cosmogenic Neutrinos from HiRes , KAI MARTENS, University of Utah, HIRES COLLABORATION — HiRes has searched its data for events that might be attributed to air showers resulting from the decay of tau leptons generated in the earth crust through the interaction of cosmogenic tau neutrinos. No candidate events were found, leading to limits on the isotropic flux of cosmogenic tau neutrinos.

12:21PM B8.00009 Neutrino and Gamma Ray Fluxes derived from the HiRes Monocular Spectra , OLGA BRUSOVA, University of Utah, HIRES COLLABORATION — HiRes data led to the observation of the GZK cutoff. A direct implication of this observation is that cosmogenic neutrinos should exist. We use injection of protons from a uniform distribution of cosmic accelerators to generate input z dependent input spectra that are then propagated through the CMB and fit to the observed monocular spectra on earth. Each accelerator injects the same power law spectrum, and z evolution of the accelerator population is modeled as (1+z)^m. We present the resulting neutrino and gamma ray fluxes at the highest energies.

Saturday, April 12, 2008 10:45AM - 12:21PM – Session B10 GGR DAP: Gravitational Waves from Compact Binary Inspirals and Mergers Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis A

10:45AM B10.00001 Searches for compact binary inspirals in LIGO data, DREW KEPPEL, Caltech - LIGO, LIGO SCIENTIFIC COLLABORATION — We describe the methodology and subtleties associated with searches for gravitational waves from coalescing compact binary systems, which have been applied to the search for low mass (Mtotal = 2 − 35M_{sun}) compact binary coalescence waveforms in the LIGO Fifth Science run (SS) first year data. We discuss the astrophysics of coalescing binaries, including the predicted waveforms and source populations. We describe the pipeline employed by the LSC to search for such waveforms in LIGO data, how we suppress false signals originating from instrumental noise, how we evaluate the search efficiency for systems which may include spinning component masses, how we establish confidence in likely detection candidates, and how we formulate Bayesian upper limits on the coalescence rate as a function of total mass of the binary system.

10:57AM B10.00002 Data quality and vetoes in searches for compact binary coalescences and bursts in LIGO’s fifth science run1, JACOB SLUTSKY, Louisiana State University, LIGO SCIENTIFIC COLLABORATION — Searches for gravitational waves from compact binary coalescences (CBCs), as well as for unmodeled sources (Bursts), are hindered by the presence of transient detector noise, which can produce false alarms. Using auxiliary channels and the gravitational wave channel itself, the LIGO Scientific Collaboration has identified a variety of instrumental and environmental artifacts that lead to false signals. We find time intervals affected by these artifacts, and use them as vetoes for CBC and Burst searches in LIGO’s fifth science run.

1Jacob Slutskey for the LSC

11:09AM B10.00003 Detection confidence tests for Inspiral Candidate Events1, SARAH CAUDILL, Louisiana State University, LIGO SCIENTIFIC COLLABORATION, VIRGO COLLABORATION — In order to detect gravitational-wave signals from compact binary inspiral, the LSC-Virgo Compact Binary Coalescence group is using an analysis pipeline which aims to reduce the false alarm rate without rejecting gravitational-wave signals. However, because of the non-Gaussian, non-stationary noise exhibited by the LIGO detectors, a large number of false alarms are found at the end of the pipeline. The Compact Binary Coalescence group has been developing a detection checklist for the validation of candidate-events. This detection checklist consists of a series of further tests including data quality checks, analysis of the candidate appearance, parameter consistency studies, coherent analysis, which aim to corroborate a detection or to eliminate a false alarm. In this talk, the methodology used for candidate validation will be presented and illustrated with interesting examples of candidates.

1LSC/VIRGO Collaboration
11:21AM B10.00004 Bayesian inference on spinning compact-binary inspirals with ground-based gravitational-wave laser interferometers

11:33AM B10.00005 Properties and application of statistical methods to estimating compact binary merger rates.

11:45AM B10.00006 Harmonic correlation for eccentric binaries in gravitational wave observations

11:57AM B10.00007 Equation of state effects on gravitational waveforms for binary neutron stars

12:09PM B10.00008 Gravitational wave observations of spinning black holes

Saturday, April 12, 2008 10:45AM - 12:33PM
Session B11 DPF: B Physics I
Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis Bldg
11:33AM B11.00005 \(B_s^0\) Meson Lifetime and \(\Delta \Gamma_s\) in the \(B_s^0 \rightarrow K^+K^-\) Decay Mode. CHIARA FARINELLI, Sapienza University of Rome, CDF COLLABORATION — The measurement of the \(B_s^0 \rightarrow K^+K^-\) lifetime allows a determination of the decay width difference \(\Delta \Gamma_s\), that is sensitive to possible new physics effects in penguin dominated \(B_s^0\) decays. In Run II of the Fermilab Tevatron, the ability to trigger on hadronic decays, has allowed the CDF experiment to collect a large sample of \(B_s^0 \rightarrow K^+K^-\) events from pp collisions at \(\sqrt{s} = 1.96\) TeV. We report on the progress toward an updated measurement of the lifetime of \(B_s^0\) mesons in this decay mode using a larger dataset than previous preliminary results.

11:45AM B11.00006 Evidence for \(b \rightarrow d\gamma\) Transitions Using a Sum of Exclusive Final States. MARK TIBBETTS, Imperial College London, BABAR COLLABORATION — Making use of a sum of exclusive final states with up to three charged pions and one neutral pion or eta, we have demonstrated that it is possible to measure the ratio of the inclusive rates \(b \rightarrow d\gamma\) and \(b \rightarrow s\gamma\). This provides information on \(|V_{td}/V_{ts}|\) that is complementary to using the exclusive modes \(B \rightarrow \rho\gamma\) and \(B \rightarrow K^+\gamma\). These results are from an analysis of data collected by the BaBar detector at the PEP-II asymmetric-energy \(e^+e^-\) storage rings at SLAC.

11:57AM B11.00007 Dalitz plot analysis of \(B^\pm \rightarrow K^{\mp\pi^\mp\pi^0}\). JENNIFER PRENDKI, University of Paris VI and VII, BABAR COLLABORATION — We report on a Dalitz plot analysis of the decay \(B^\pm \rightarrow K^{\mp\pi^\mp\pi^0}\) performed by the BABAR experiment using a data sample with 383 million \(B\) meson pairs. An isobar model including vector and scalar components is fitted to the data. From the fitted amplitudes the component branching fractions and CP charge asymmetries are extracted as well as constraints on some phases. How these measurements could possibly impact the determination of CKM parameters will be discussed.

12:09PM B11.00008 Search for the decay \(B^+ \rightarrow K^+\nu\bar{\nu}\). DAVID DOLL, California Institute of Technology, BABAR COLLABORATION — We present a search for the decay \(B^+ \rightarrow K^+\nu\bar{\nu}\) performed with data collected by the BaBar detector at the PEP-II asymmetric energy storage rings. The analysis is carried out in the recoil of a reconstructed \(B\) using semileptonic tags (the tagged \(B\) decays in a \(D^{(*)}\nu\nu\) or \(D\pi\nu\nu\) channel). We performed this study using both a cut-and-count method (BumpHunter tool in StatPatternRecognition), and multivariate approach (Random Forest tool included in StatPatternRecognition). A comparison of these studies is given.

12:21PM B11.00009 Observation of \(\Upsilon(1S) \rightarrow \gamma K_S^0K_S^0\). DANIEL HOGAN, Kansas University, CLEO COLLABORATION — Using data collected by the CLEO III detector at the Cornell Electron Storage Ring (CESR), we report on the observation of the radiative decay of \(\Upsilon(1S)\) to \(K_S^0K_S^0\) via production of \(f_2(1525)\). The \(\Upsilon(1S) \rightarrow \gamma f_2(1525)\) branching ratio obtained is consistent with previous measurements.

Saturday, April 12, 2008 10:45AM - 12:21PM — Session B12 DPF: Detectors II

10:45AM B12.00001 The Upgraded CDF II Fast Track Trigger. ROBERT FORREST, University Of California, Davis — The CDF eXtremely Fast Tracker (XFT) trigger system reconstructs charged particle tracks transverse to the beam line using hit data from the axial layers of the central drift chamber. These tracks are then associated with activity in other detector elements to find electron and muon candidates for use in trigger decisions. The XFT system has been upgraded to make use of the existing stereo layers of the chamber. The upgrade improves fake rejection, as well as enabling three dimensional reconstruction and extrapolation of tracks at the trigger level. This results in a higher purity of selected events, and controls the non-linear growth of trigger rates with increasing instantaneous luminosity. We describe the upgraded XFT system and present preliminary results on its performance with collision data at various high instantaneous luminosities.

10:57AM B12.00002 Performance and Longevity Studies of the Silicon Detector of the CDF Experiment. ROBERTO MARTINEZ BALLARIN, OSCAR GONZALEZ LOPEZ, IGNACIO REDONDO FERNANDEZ, CIEMAT, CDF COLLABORATION — The CDF Silicon Detector is a system devoted to make precision tracking and vertex measurements. The silicon detector is used in regular data taking, having collected more than 3.0 fb\(^{-1}\) of data during the Run II of the Tevatron Collider at Fermilab. The silicon detector is exposed to extreme conditions of irradiation so it provides an exceptional opportunity to study the effects of a prolonged high-radiation environment on silicon sensors. In this talk we describe the tools and comment the results obtained in CDF to monitor and investigate the evolution of the silicon detector performance as radiation damage becomes more severe, specifically after the innermost layers of the detector have crossed the so-called inversion point.

11:09AM B12.00003 Study of Beam-Induced Radiation in the CMS Detector at the Large Hadron Collider. ANIL SINGH, Fermilab/Panjab University, PUSHPALATHA BHAT, Fermilab, Batavia, IL60510, SUMAN BERI, NIKOLAI MOKHOV, Fermilab, Batavia, IL60510 — The intense radiation environment at the Large Hadron Collider (CERN) at the design energy of \(\sqrt{s}=14\) TeV and luminosity of \(10^{34}\) cm\(^{-2}\) sec\(^{-1}\) poses unprecedented challenges for safe operation and performance quality of the silicon tracker detectors in the CMS and ATLAS experiments. The silicon trackers are crucial for the physics at the LHC experiments, and the inner layers, being situated only a few centimeters from the interaction point, are most vulnerable to beam-induced radiation. We have recently carried out extensive monte carlo simulation studies using MARS program to estimate particle fluxes and radiation dose in the CMS silicon pixel and strip trackers from proton-proton collisions and from machine background such as beam-gas interactions and beam-halo. We have also studied some possible machine accident scenarios. We will present results on radiation dose, particle fluxes and spectra from these studies and discuss implications for radiation damage and performance of the CMS silicon tracker detectors.

3 We thank the LHC Physics Center at Fermilab for support of Mr. Singh.

11:21AM B12.00004 Performance of CMS Endcap Muon Chambers. VICTOR BARASHKO, University of Florida, CMS COLLABORATION — In the Compact Muon Solenoid (CMS) Experiment, muon detection in the forward direction is accomplished by the Endcap Muon System comprised of 468 Cathode Strip Chambers (CSC). These detectors also provide fast muon trigger and give a precise measurement of the muon trajectory. We present results of the detector performance analysis based on the cosmic ray data collected by the CMS experiment in 2006, with about 8% of the full system (36 CSCs) operating for a few months. We show that CMS CSCs identify 2-dimensional trigger primitives with 99.9% efficiency. These segments, found by the CSC electronics in less than 500 ns after passing of a muon through the chambers, are the input information for the Level-1 muon trigger and, also, are a necessary condition for chamber raw data read-out by the Data Acquisition System. The spatial resolution per chamber is measured to be around 100-200 microns (CSC resolution depends on strip width, which varies for the chambers from 4 to 16 mm). In contrast to the earlier studies based on a total detector area typically limited to 0.01 sq.m. (efficiency) and 3 sq.m. (resolution), results presented in this report were obtained for many installed CSCs operating in situ over an area of 20 sq.m. (efficiency) and 60 sq.m. (spatial resolution).
11:33AM B12.00005 Beam Test Results for ATLAS Muon Micromegas, WOOCHUN PARK, University of South Carolina, ATLAS MUON MICROMEGAS COLLABORATION — MicroMegas (MicroMesh GASEous Structure) technology is a promising candidate to replace the ATLAS muon tracking and trigger chambers in the end-cap inner layer and in the highest rapidity region of the middle layer for a future Super-LHC version of the experiment. A small prototype was built and evaluated in a beam test performed at the CERN H6 in November 2007. Some preliminary results on the performance are presented.

11:45AM B12.00006 Track-based alignment of the CMS muon detector, JIM PIVARSKI, Texas A&M University, CMS COLLABORATION — The outermost layer of the CMS experiment measures muon tracks with over 700 independent tracking chambers, mounted on modular wheels and disks. These supports can shift and flex under the magnetic force of the CMS solenoid, so the positions and orientations of the chambers must be determined under operating conditions. Two methods will be used to identify the chambers' true locations: a survey system built into the detector and a software-based optimization of tracks. We will discuss the latter, which poses interesting challenges due to the large amount of material between muon chambers. Proper alignment of the muon system is one of the most significant factors in muon momentum resolution above 1 TeV.

11:57AM B12.00007 Alignment of the Inner Detector of the ATLAS Experiment, SOPHIO PATARAIA, Max Planck Institute for Physics, Munich, Germany, ATLAS COLLABORATION — The ATLAS Experiment is a general purpose detector that will operate at the Large Hadron Collider at CERN in Geneva, Switzerland. In order to achieve its physics goals, the ATLAS tracking requires that the position of the silicon detector elements have to be known to a precision better than about 10 micrometers. This precision can only be achieved by track based alignment algorithms. In this presentation the startup plans for the ATLAS Inner Detector are presented. This includes the implementation of the alignment algorithm in the overall computing model as well as tests of misaligned detector setups using simulated data.

12:09PM B12.00008 Test beam results from the CMS Zero Degree Calorimeters 1, JEFFREY WOOD, University of Kansas, CMS COLLABORATION — The CMS Zero Degree Calorimeters are designed to measure forward neutrons and photons in TeV scale pp and heavy ion collisions. We will present test beam results from electron and pion beams in the energy range of 20-350 GeV. We will discuss the resolution and linearity of the detector as a function of energy. For pp collisions we expect to see protons with energies as high as the beam energy, 7 TeV. This energy is 20 times larger than the highest available test beam energy and so calibration is a particular challenge. Finally we will describe how we plan to use the detector for early physics measurements at the LHC.

Saturday, April 12, 2008 10:45AM - 12:33PM – Session B13 DNP: Minisymposium on Nuclear Physics Deep Underground I

10:45AM B13.00001 Going Deep - Nuclear Science Underground, JOHN F. WILKERSON, Center for Experimental Nuclear Physics and Astrophysics, University of Washington — The creation of a Deep Underground Science and Engineering Laboratory (DUSEL) at the Homestake Mine in South Dakota as well as the construction of SNOLAB in Sudbury, Ontario provide exciting new opportunities for the nuclear science community. The proposed next generation of underground experiments to be sited at these facilities aim to investigate a broad set of fundamental questions: What is the nature of neutrinos? Can we directly detect dark matter? How did the elements originate? What nuclear reactions are important to stellar evolution and dynamics? How did the matter - antimatter asymmetry we observe in the universe arise? Answers to these questions impact not only nuclear physics, but particle physics, astrophysics, and cosmology. There are numerous technical challenges that need to be met, including attaining unprecedented levels of material purity, developing ultra-sensitive assay techniques, and improving our understanding of nuclear properties. Likewise there are a number of interesting theoretical issues that need to be addressed including improving our knowledge of nuclear matrix elements and understanding the limits of nuclear stability. This talk will give an overview of the physics, the experiments, and the technologies that will help us reach a better view of our universe by going deep underground.

11:21AM B13.00002 EXO-200 Status, DEREK MACKAY, Stanford University, EXO COLLABORATION — EXO-200 (Enriched Xenon Observatory-200 kg) is an underground double-beta decay experiment that uses 200 kg of Xenon isotopically enriched to 80% in Xenon-136. The Xenon is contained in an ultra-low background TPC where there is simultaneous collection of scintillation light (using Large Area Avalanche Photodiodes (LAAPD’s) ) and ionization charge in order to significantly enhance the energy resolution. EXO-200 should measure the, as yet unobserved, two neutrino double-beta decay mode as well as achieve competitive sensitivity for the neutrinoless double-beta decay mode of Xenon-136. EXO-200 was moved from Stanford University in August of 2007 and is currently under a 2000 meter water-equivalent overburden at the WIPP site in New Mexico.

11:33AM B13.00003 Development of barium tagging technology for EXO, MARIA MONTERO DIEZ, Stanford University, EXO COLLABORATION — The Enriched Xenon Observatory (EXO) is a series of experiments designed to search for the neutrinoless double beta decay of Xenon-136. The first experiment, known as EXO-200, is comprised of a liquid xenon TPC containing 200 kg of xenon enriched to 80% in Xenon-136 and is nearing completion. To suppress possible radioactive backgrounds, the EXO collaboration is also pursuing the development of a new technique to identify the production of the barium daughter ions produced by double beta decay. For this purpose, a linear radio-frequency ion trap has been constructed. Individual barium ions are trapped in this helium or argon buffer gas-filled trap and observed with a high signal-to-noise ratio by resonance fluorescence. Furthermore, two ion transfer methods are under parallel development, both involving the capture and transport of the ions on the surface of a specially designed tip. This talk will present the results obtained in the trapping of single buffer gas-cooled barium ions and the transfer of ions using a cryogenic tip, and our plans for an ion transfer tip using resonance ionization spectroscopy.

11:45AM B13.00004 The MAJORANA Neutrinoless Double-beta Decay Experiment, VINCENTE GUISEPPE, Los Alamos National Laboratory, MAJORANA COLLABORATION — Neutrinoless double-beta decay searches play a major role in determining the effective Majorana neutrino mass as well as the Majorana neutrino sector and a leptonicviolating process. The MAJORANA experiment proposes to assemble an array of HPGe detectors to search for neutrinoless double-beta decay in 76Ge. Initially, MAJORANA aims to construct a prototype system containing 60 kg of Ge detectors to demonstrate the potential of a future 1-tonne experiment. The design and potential reach of the prototype system will be presented. This talk will also discuss material purity, detector optimization, background rejection, identification of rare backgrounds, and other key technologies to be utilized in the MAJORANA experiment.
11:57AM B13.00005 Methods for deploying ultra-clean detectors. ALEXIS SCHUBERT, University of Washington, MAJORANA COLLABORATION — Next-generation underground experiments, such as searches for neutrinoless double-beta decay and dark matter experiments, will perform high-sensitivity measurements that require extremely low backgrounds. The MAJORANA Collaboration proposes an experiment to search for neutrinoless double-beta decay using an array of germanium crystals enriched in $^{76}$Ge. The design of the MAJORANA experiment must minimize backgrounds while meeting criteria for electrical signal quality, structural integrity, and thermal cooling characteristics. Recent work has addressed detector deployment in ultra-low-background environments. Advances have been made in fabrication of radiologically pure copper parts. Prototype designs for detector support structures reduce backgrounds by minimizing component mass and making use of ultra-pure materials. This talk will describe the design and use of cryostat test-stands to investigate the performance of prototype designs for detector strings. While MAJORANA uses germanium detectors, the design considerations and progress made by the collaboration are applicable to other detector technologies and fields of research.


12:09PM B13.00006 The development of LENS. JEFF BLACKMON, Louisiana State University — The Low-Energy Neutrino Spectroscopy (LENS) Collaboration aims to precisely measure the entire energy spectrum of solar neutrinos, including low-energy neutrinos from $p+p$ fusion, through charged-current neutrino interactions on indium in real time. Such a measurement would provide important insights into our understanding of the sun and of neutrino properties. To achieve this goal, we have developed a detector design based on a large, highly-segmented volume of liquid scintillator, which we call the scintillation lattice. The spatial segmentation of the scintillation lattice allows even low-energy neutrino interactions to be distinguished from background sources. We are currently constructing an approximately 1 m$^3$ prototype instrument, miniLENS, that will demonstrate the detector performance and determine the optimum route to scale to an $\approx$ 200 ton instrument. The detector design, the status of the R&D program, and plans to deploy a full-scale instrument underground will be discussed.

1on behalf of the LENS Collaboration

12:21PM B13.00007 Metal Loaded Organic Liquid Scintillator for the LENS Experiment. STEVEN DEREK ROUNTREE, Virginia Tech, ZHENG CHANG, South Carolina State University, MINFANG YEH, RICHARD HAHN, Brookhaven National Laboratory, RAJU RAGHAVAN, Virginia Tech, LENS COLLABORATION — LENS is a low energy neutrino experiment that will measure the solar neutrino spectrum above 114keV which accounts for $\approx$95% of the solar neutrino flux. It will allow us to measure the solar luminosity in neutrinos, test the current LMA-MSW oscillation model independently from solar models, and probe the temperature profile of solar energy production, as well as search for sterile neutrino oscillations using an artificial neutrino source. The experimental tool is charged-current capture of the neutrino on In115, with prompt emission of an e- and delayed emission of 2 gamma rays that serve as a time/space coincidence tag. LENS requires $\approx$10 tons of Indium be loaded into 100,000 liters of organic scintillator (pseudocumene, linear alkylbenzene) via liquid-liquid extraction. Results of several years of development will be described. The key properties of the Indium scintillator are: high metal loading (8-10%), long attenuation length at 430nm ($\approx$8m), high scintillation yield, stability on the scale of years.

1This work was funded in part by NSF and DOE.

1Low Energy Neutrino Spectroscopy

Saturday, April 12, 2008 10:45AM - 11:45AM — Session B14 DNP: Nucleon Spin Structure at High Energy — Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis G

10:45AM B14.00001 Latest Results on the Flavor-Separated Parton Distribution Functions of the Nucleon at HERMES. JOSHUA RUBIN, University of Illinois Urbana-Champaign, HERMES COLLABORATION — Through semi-inclusive deep-inelastic scattering (DIS), the HERMES collaboration has accessed many features of the structure of the nucleon. By taking into account the identity of final-state hadrons and their correlation with particular struck-quark flavors in the DIS process, the individual quark contributions to the nucleon structure functions have been unraveled. New results on the quark helicity distributions, $\Delta q(x)$, extracted from double-spin inclusive and hadron asymmetries, will be presented. Previously overlooked data have been included and improved analysis methods, which better leverage the full statistical power of the data, are utilized. Additionally, an improved method for estimating the fragmentation model contribution to the systematic uncertainties of the result has been included. This new analysis significantly reduces previously published systematic and statistical uncertainties and explores previously uninvestigated features of the quark polarizations. In addition, other new HERMES results related to the extraction of parton distribution functions will be presented.

10:57AM B14.00002 Measurement of the Double Longitudinal Spin Asymmetry for Inclusive Hadron Production in 200 GeV Polarized p+p Collisions at RHIC. BERND SURROW, MIT, STAR COLLABORATION — A primary goal of the STAR-spin program is the measurement of the gluon polarization, $\delta g$, in the proton. The STAR detector, with its large acceptance and high-precision calorimeters and tracking, provides a uniquely suited environment for asymmetry measurements in a number of different final-state channels in polarized $p+p$ collisions. These asymmetries will provide significant contributions to a global analysis of $\delta g$. We present the most recent measurements of the double longitudinal spin asymmetry ($A_{LL}$) for the inclusive production of both neutral and charged pions at mid rapidity. These asymmetries are compared to NLO pQCD calculations for different polarization scenarios and are used to provide constraints on $\delta g$. Charged pions are of particular interest as they are sensitive to the sign of $\delta g$. Results and continuing analyses are presented from RHIC runs 5 and 6.

11:09AM B14.00003 Inclusive Jet and Dijet Cross Section and Longitudinal Double Spin. TAI SAKUMA, MIT, STAR COLLABORATION — The polarized gluon distribution in the proton, $\delta g$, is of particular interest to the STAR Spin program. Double spin asymmetry, $A_{LL}$, of the jets production rate is sensitive to $\delta g$. With it’s large acceptance electromagnetic calorimetry and tracking system, STAR is well suited for these measurements. We report the status of the measurements of inclusive jet and dijet cross section and $A_{LL}$ for the polarized proton-proton collision data taken during RHIC 2005 and 2006 run.
11:21AM B14.00004 Inclusive $\pi^0$ Production in Longitudinally Polarized pp Collisions at $\sqrt{s}=200$ GeV Using the STAR Endcap Electromagnetic Calorimeter

WEIHONG HE, Indiana University, STAR COLLABORATION — Measurement of the double-spin asymmetry $A_{LL}$ for inclusive $\pi^0$ production in polarized pp collisions can provide important constraints on gluonic contributions to the proton's spin. The STAR Endcap Electromagnetic Calorimeter (EEMC) is well suited for these studies, providing full azimuthal coverage for $1.0 < \eta < 2$. Detailed results will be presented. The EEMC also provides fast triggering on significant energy deposition in individual towers, trigger patches, or jet patches ($\Delta p_t \times \Delta \phi \approx 0.007, 0.06, 1$, respectively). Details of the $\pi^0$ reconstruction algorithm employed, and the current status of analysis of the 2006 longitudinally polarized pp data set (sampled luminosity $\approx 3.5$ pb$^{-1}$) will be presented.


11:33AM B14.00005 The STAR Forward GEM Tracker

BERND SURROW, MIT, STAR COLLABORATION — The STAR collaboration is preparing a tracking detector upgrade, the Heavy Flavor Tracker (HFT) and the Forward GEM Tracker (FGT) to further investigate fundamental properties of the new state of strongly interacting matter produced in relativistic-heavy ion collisions at RHIC and to provide fundamental studies of the proton spin structure and dynamics in high-energy polarized proton-proton collisions, determining the flavor dependence ($\Delta u$ versus $\Delta d$) of the polarized sea. These polarization parton distribution functions (PDFs) are only weakly constrained by polarized fixed target experiments, giving limited insight into the underlying mechanisms which produce the polarized sea. STAR plans to probe these PDFs using parity violating W production and decay. The production of $W^{(-)}$ bosons provides an ideal tool to study the spin-flavor structure of the proton. $W^{(-)}$ bosons are produced in $u + d (d + u)$ collisions and can be detected through their leptonic decays, $e^- + \nu_e (e^+ + \nu_e)$, where only the respective charged lepton is measured. The sensitivity of those measurements is enhanced in the forward direction. The discrimination of $u + d (d + u)$ quark combinations requires distinguishing between high $p_T$ $e^- (+)$ through their opposite charge sign, which in turn requires precise tracking information. An upgrade of the STAR forward tracking system is needed to provide the required tracking precision for charge sign discrimination. This upgrade will consist of six triple-GEM detectors with two dimensional readout arranged in disks along the beam axis. The FGT design, the performance of triple-GEM prototype detectors based on industrially produced GEM foils along with the status of the FGT construction and the anticipated installation schedule will be presented.

Saturday, April 12, 2008 10:50AM - 12:30PM — Session 6HE HEDP HEDLA: Shocks in Stellar Jets

10:50AM 6HE.00001 Observed Hydrodynamical Properties of Stellar Jets

PATRICK HARTIGAN, Rice University — Jets from young stars are probably the best astronomical objects for studies of supersonic fluid dynamics. These remarkable collimated flows consist of multiple bow shocks which form in response to velocity perturbations. In at least two cases, jets deflect from obstacles located along the path of the flow and produce spectacular shocked wakes and shear. The hot gas behind the shocks in stellar jets radiates optically thin forbidden lines, from which one can measure turbulent line widths, densities, ionization fractions, and temperature, and even watch how the jets and shocks evolve in real time. This talk will summarize the important properties of these flows, and present new observations from the Hubble Space Telescope and from ground-based telescopes relevant to understanding fluid dynamics of stellar jets. A variety of laboratory experiments involving the dynamics of high Mach number jets and shock waves have become increasingly relevant to our understanding of this fundamental astrophysical process.

1 NLUF/DOE

11:15AM 6HE.00002 Turbulence, Outflows and Feedback

ADAM FRANK, University of Rochester — In this talk I review progress on the study of protostellar outflows altering the environment into which they propagate. Using high resolution simulations we explore the ability of outflows to generate and maintain turbulence in the clouds from which they were born. In addition we explore the nature of the jets themselves in terms of new models in which the jets are, essentially, composed of a series of clumps of various densities propagating with a distribution of speeds through a background, inter-clump medium. These models are supported both by observations and recent laboratory experiments.

11:40AM 6HE.00003 Experiments with supersonic plasma jets at Omega

JOHN M. FOSTER, AWE Aldermaston — Large-scale directional outflows of supersonic plasma, also known as jets, are often encountered in astrophysics. These jets propagate through the interstellar medium which is often clumpy and where inhomogeneities affect the morphology of the shocks that are generated. The hydrodynamics is difficult to model as the problem is inherently 3D, and the clumps are subject to a variety of fluid instabilities as they are accelerated and destroyed by shocks. Very large scale inhomogeneities may result in deflection of the jet itself. The traditional approach to understanding such phenomena is through theoretical analysis and numerical simulations. However, such numerical simulations have limited resolution, often assume axial symmetry, do not include all relevant physical processes, and may fail to scale correctly in Reynolds number and other key dimensionless parameters. They are frequently not tested by comparison with laboratory experiments. In recent years, we have carried out experiments at the University of Rochester's Omega laser, to investigate the physics associated with the propagation of plasma jets and shocks through both homogeneous and inhomogeneous media. These experiments have close analogues with structures observed in jets from young stars. Jets and shocks are created in experimental assemblies that are ablative driven by a 190-eV temperature 'holohraum' (which is itself heated by the Omega laser), and subsequently propagate into a low density hydrocarbon-foam medium. The foam is either of uniformly low density, or contains localised (higher density) perturbations. Interaction of jets with this fluid results in the development of a bow shock, and, in the case of a single density perturbation, results in deflection of the jet (a laboratory analogue of the astrophysical object HH110). In the case of a shock propagating through an inhomogeneous medium (foam containing one or more sapphire spheres), the resulting complex shock interactions are analogous to the flow of clumpy interstellar matter through the working surfaces of HH objects. The hydrodynamic structures that develop in these experiments are revealed by x-ray 'backlighting' radiography. These complex experimental data challenge both astrophysical and laser-plasma hydrodynamics computer codes. We discuss 2D and 3D simulations of these experiments, and their potential scaling to astrophysical systems.
Laboratory studies can address issues relevant to astrophysics and in some cases improve our understanding of the physical processes that occur in astrophysical objects. So issues related to the jet propagation and collimation over considerable distance and their interactions with surrounding media have begun to be addressed these last years. Laboratory plasmas and astrophysical objects have different length, time and density scales. However, the typical velocities are the same, of a few hundred km/s and the similarity criteria can be applied to scale the laboratory jets to astrophysical conditions. In this presentation, we use a method of jet formation which allows to launch a very fast jet having a velocity around 400 km/s by using a relatively small laser energy, of the order of 100 J. The jet has a Mach number greater than 10, a length of a few mm, and a radius of a few tenths of mm. The injection of these jets with a gas puff has been recently studied in an experiment carried out at the PALS laser facility. Varying gas pressure and composition, we show that the nature of interaction zone changes from a quasi adiabatic outflow to a strongly radiatively cooling jet. The use of various diagnostics, allows to relate the x-ray emission to the density map of the interaction zone. Already observed in astrophysical objects for strongly different time and space scales, these structures are interpreted in our laboratory experiment by using a semi- analytical model and 2D radiation hydrodynamic simulations. [1] B. Remington et al, Rev. Mod. Phys. 78, 755 (2007) [2] D. Ryutov et al, Phys. Plasmas 8, 1804 (2001) [3] Ph. Nicolai et al, Phys. Plasmas 13, 062701 (2007)

Saturday, April 12, 2008 1:30PM - 3:18PM –
Session D2 DPF: Collider and Heavy Flavor Physics

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis D

1:30PM D2.00001 The Accomplishments of the CESR/CLEO Program
SHELDON STONE, Syracuse University — The CLEO experiment, that uses the Cornell Electron Storage Ring (CESR), took data from Nov. 1979 to April 2008. Both the machine and the detector have gone through several different major phases caused by implementing new technologies, mostly locally developed. The improved sensitivities usually resulted in major discoveries. Many particles were first seen at CLEO and many important decay modes were first seen, or measured with far more accuracy than done before. Discoveries include the first observations of the $\Upsilon(5S)$, $\Upsilon(4S)$, $p^0$, $B^\pm$, $D_S^\pm$, $\Upsilon(1D)$ and $D_{sJ}(2460)$ mesons, and the $\Sigma^\pm$, $\Sigma^*_\pm$, $\Sigma^{*0}$, $\Xi^\pm$, $\Xi^*_\pm$, and $\Xi^{*0}$ baryons. First observations of new processes include b-quark semileptonic decays, including the rare semileptonic decay $b \rightarrow u\ell\nu$, the “Penguin” process $b \rightarrow s\gamma$, and the important exclusive decays $B \rightarrow J/\psi K_S$ and $D^* \rightarrow \mu^+\nu$. Recently, the decay rates for $D^*_s \rightarrow p^+\nu$ and $D^*_s \rightarrow e^+\nu$ have been measured with unprecedented accuracy, posing a challenge to Lattice QCD calculations. New accelerator and detector technologies have also had an impact on ensuing particle physics experiments and detectors in other fields. Decreasing the size of the CESR beams in the interaction region (so-called micro-beta sizes) led to a large increase in instantaneous luminosity. Multi-bunch schemes, where many particle bunches and bunch trains are brought into collision also increased the luminosity. In a parallel effort, CESR has maintained a cutting edge synchrotron radiation facility that has produced many interesting results. Pioneering detector technologies were implemented in the areas of electromagnetic calorimetry, tracking, vertexing and particle identification. For example, in calorimetry, CLEO developed a system using CsI crystals with photodiode read-out inside a 1.5 T magnetic field, that provides excellent energy resolution as well as accurate measurements of photon positions and angles. Particle identification has a long history of developments starting with a separate stand-alone dE/dx system that was replaced with a 51 layer drift chamber having dE/dx measurement in each layer, and finally adding a Ring Imaging Cherenkov detector using LIF radiators and Triethyamine based wire-chamber photon-detectors. I will review these achievements and some of their impacts.

1Supported by the National Science Foundation and Dept. of Energy

2:06PM D2.00002 Charm Mixing
RAY COWAN, Massachusetts Institute of Technology — Compelling evidence for charm meson mixing was announced in spring 2007 by the BaBar and Belle Collaborations. This presentation will review the phenomenology of charm mixing and CP violation and survey the experimental progress made in searching for charm mixing over the last year. Results from semileptonic and two- and multi-body hadronic decays will be presented.

2:42PM D2.00003 New States in Charm and Beauty Spectroscopy
ALEXEY DRUTSKOY, University of Cincinnati — Recent experimental results in charm and beauty spectroscopy are discussed. During the last few years, many new $D$ and $B$ resonances and charmonium and bottomonium states have been discovered. An overview of these measurements and the experimental techniques used is reported in this talk. Within potential models, the observed states can be classified with respect to their masses, widths, quantum numbers, and decay modes. Some of new states cannot be satisfactorily classified, and their possible interpretation as multiquark, hybrid or glueball candidates is discussed.

Saturday, April 12, 2008 1:30PM - 3:18PM –
Session D3 DPF: Quantum Chromodynamics

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis E

1:30PM D3.00001 The Accomplishments of HERA
ALLEN CALDWELL, Max Planck Institute — The HERA accelerator stopped operation at the end of June, 2007, after 15 years of successfully delivering data to the ZEUS, H1, HERMES and HERA-B experiments. The main features and accomplishments of HERA will be described. The main results of the H1 and ZEUS experiments in the area of strong interaction physics will then be reviewed: structure function measurements, rapidity gap physics, jet physics and the extraction of the strong coupling constant. Recent theoretical developments in understanding the HERA data will also be discussed, with focus on the striking behavior of the small-x data.

2:06PM D3.00002 From the Age of Discovery to the Age of Exploration: Determining the Properties of the Quark-Gluon-Plasma
THOMAS ULLRICH, Brookhaven National Laboratory — In one of the most surprising discoveries of the past few years, experiments at the Relativistic Heavy Ion Collider (RHIC) have identified a new form of matter formed in nucleus-nucleus collisions at energy densities more than 100 times that of a nuclear fireball. Measurements and comparisons with relativistic hydrodynamic models indicate that the matter thermalizes in an unexpectedly short time, has an energy density at least 15 times larger than needed for color deconfinement, has a temperature about twice the critical temperature predicted by lattice QCD, and appears to exhibit collective motion with ideal hydrodynamic properties - the “perfect liquid.” The matter appears to flow with a near-zero viscosity-to-entropy ratio, lower than any previously observed fluid and close to a universal lower bound recently derived from string theory. Although these results so far indicate that the quark-gluon plasma formed in the collisions at RHIC is a strongly coupled plasma and not a dilute gaseous plasma as originally expected. However, a fundamental understanding of the medium seen in heavy-ion collisions at RHIC does not yet exist. The most important scientific challenge for the field in the next decade is the quantitative exploration of the new state of matter, i.e., to quantify its properties and to understand precisely how they emerge from the fundamental properties of QCD. This will include the search for the critical endpoint in the QCD phase diagram, the discovery of which is a distinct possibility in a series of low energy runs at RHIC. The next steps at RHIC will require new data that will, in turn, require enhanced capabilities of the RHIC detectors and accelerator. I will report on recent measurements and their implications for our current understanding of the hot and dense matter created at RHIC, as well as the scientific opportunities for an upgraded RHIC (RHIC II) in conjunction with upgrades to the large experiments, PHENIX and STAR.
1:30PM D4.00001 The Three-Nucleon Analyzing Power Puzzle - The Past 20 Years1. WERNER TORNOW, Duke University & TUNL — The three-nucleon (3N) analyzing power A_y(θ) puzzle (3NAPP) refers to the failure of rigorous 3N calculations to account for the magnitude of the measured nucleon-deuteron A_y(θ) in the angular region of the A_y maximum (30% underprediction). The 3NAPP is a low-energy phenomenon and does not refer to A_y(θ) in the energy range above 100 MeV, where standard 3N forces contribute significantly to A_y(θ) in the angular region of the cross-section minimum. The 3NAPP was discovered by Witata, Glöckle and Cornelius in 1987 when they compared their rigorous 3N calculations to the neutron-deuteron (n-d) data of the Tübingen/TUNL group, although some evidence of a possible problem with describing A_y(θ) was already reported in 1986 by Koike and Haidenbauer. Before 1995 the 3NAPP was solely a n-d scattering phenomenon. However, with the Coulomb problem solved in 3N calculations by Kivsky, Viviani and Rosati in 1995 for energies below, and in 1999 for energies above the deuteron breakup threshold, the 3NAPP entered a new stage and included A_y(θ) in proton-deuteron (p-d) scattering as well as the vector analyzing power iT_11(θ) in d-p scattering. Although p-d phase-shift analyses and their comparison to theoretical phase shifts provided some insight into the physics of the 3NAPP, the accurate p-d data initially created a new problem at energies below about 5 MeV, until the theoretical treatment of the magnetic moment interaction by Witata et al. and Kivsky et al. provided a uniform picture. The recent inclusion of relativity in 3N calculations by Witata et al. has increased the 3NAPP at low energies considerably (by about 25% at 5 MeV). Furthermore, the new n-d A_y(θ) data obtained by Weisel et al. at TUNL confirmed our conjecture that the transition region between 20 MeV and about 35 MeV, above which the 3NAPP disappears, is poorly understood. Here, p-d data are needed to make progress. Currently, the hope is that the 3N force terms predicted by Chiral Effective Field Theory in N3LO will eventually provide the correct explanation of the 3NAPP. However, the range of the required 3N force terms has to be about 3 fm in order to describe the A_y(θ) and iT_11(θ) data at E_c.m. =432 keV.

1Work supported by US DOE, Office of Nuclear Physics, Grant # DE-FG02-97ER41033

1:30PM D4.00002 Towards a Microscopic Density Functional Theory for Nuclei1. SCOTT BOGNER, Michigan State University — Density functional theory (DFT) has enjoyed spectacular success describing inhomogeneous many-electron systems in condensed matter physics and chemistry where ab initio methods become computationally prohibitive, as was recognized by the Nobel Prize awarded to Walter Kohn in 1998. Because of the computational limitations of ab initio methods in medium and heavy nuclei, DFT is the only tractable many-body method that can at present be applied across the entire table of nuclides. Remarkably simple phenomenological functionals of the Skyrme and Gogny type have enjoyed nearly four decades of impressive success describing a wide range of nuclear properties for many different mass regions. However, different parameterizations lead to uncontrolled (i.e., parameterization-dependent) extrapolations far from stability, with no reliable method to estimate the theoretical error bars. A primary objective of the SciDAC project “Building a Universal Nuclear Energy Density Functional (UNEDF)” is to develop a microscopically-based, energy density functional applicable to all nuclei in the form of a generalized Skyrme functional, with theoretical error bars for the different terms in the UNEDF to provide guidance for fine-tuning to data and to give controlled extrapolations away from stability. In this talk, I describe a promising route for achieving these objectives that combine recent advances in chiral effective field theory (EFT) inter-nucleon interactions, renormalization group (RG) techniques for nuclear systems, and nuclear many-body computational methods.

1Supported in part by Department of Energy Grant No. DE-FC02-07ER41457

1:30PM D5.00001 How We Learned the Stars Run on Nuclear Energy1. MATTHEW STANLEY, Michigan State University — No abstract available.

2:42PM D3.00003 Lattice QCD. JOZEF DUDEK, Jefferson Lab / Old Dominion University — I will review recent progress in using Lattice QCD to describe hadron physics including spectroscopy, hadron structure and heavy-flavor physics.

Saturday, April 12, 2008 1:30PM - 3:18PM –
Session D4 DNP GFB: Few Body Nuclear Physics II Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade B

1:30PM D4.00001 The Three-Nucleon Analyzing Power Puzzle - The Past 20 Years1. WERNER TORNOW, Duke University & TUNL — The three-nucleon (3N) analyzing power A_y(θ) puzzle (3NAPP) refers to the failure of rigorous 3N calculations to account for the magnitude of the measured nucleon-deuteron A_y(θ) in the angular region of the A_y maximum (30% underprediction). The 3NAPP is a low-energy phenomenon and does not refer to A_y(θ) in the energy range above 100 MeV, where standard 3N forces contribute significantly to A_y(θ) in the angular region of the cross-section minimum. The 3NAPP was discovered by Witata, Glöckle and Cornelius in 1987 when they compared their rigorous 3N calculations to the neutron-deuteron (n-d) data of the Tübingen/TUNL group, although some evidence of a possible problem with describing A_y(θ) was already reported in 1986 by Koike and Haidenbauer. Before 1995 the 3NAPP was solely a n-d scattering phenomenon. However, with the Coulomb problem solved in 3N calculations by Kivsky, Viviani and Rosati in 1995 for energies below, and in 1999 for energies above the deuteron breakup threshold, the 3NAPP entered a new stage and included A_y(θ) in proton-deuteron (p-d) scattering as well as the vector analyzing power iT_11(θ) in d-p scattering. Although p-d phase-shift analyses and their comparison to theoretical phase shifts provided some insight into the physics of the 3NAPP, the accurate p-d data initially created a new problem at energies below about 5 MeV, until the theoretical treatment of the magnetic moment interaction by Witata et al. and Kivsky et al. provided a uniform picture. The recent inclusion of relativity in 3N calculations by Witata et al. has increased the 3NAPP at low energies considerably (by about 25% at 5 MeV). Furthermore, the new n-d A_y(θ) data obtained by Weisel et al. at TUNL confirmed our conjecture that the transition region between 20 MeV and about 35 MeV, above which the 3NAPP disappears, is poorly understood. Here, p-d data are needed to make progress. Currently, the hope is that the 3N force terms predicted by Chiral Effective Field Theory in N3LO will eventually provide the correct explanation of the 3NAPP. However, the range of the required 3N force terms has to be about 3 fm in order to describe the A_y(θ) and iT_11(θ) data at E_c.m. =432 keV.

1Work supported by US DOE, Office of Nuclear Physics, Grant # DE-FG02-97ER41033

2:06PM D4.00002 Towards a Microscopic Density Functional Theory for Nuclei1. SCOTT BOGNER, Michigan State University — Density functional theory (DFT) has enjoyed spectacular success describing inhomogeneous many-electron systems in condensed matter physics and chemistry where ab initio methods become computationally prohibitive, as was recognized by the Nobel Prize awarded to Walter Kohn in 1998. Because of the computational limitations of ab initio methods in medium and heavy nuclei, DFT is the only tractable many-body method that can at present be applied across the entire table of nuclides. Remarkably simple phenomenological functionals of the Skyrme and Gogny type have enjoyed nearly four decades of impressive success describing a wide range of nuclear properties for many different mass regions. However, different parameterizations lead to uncontrolled (i.e., parameterization-dependent) extrapolations far from stability, with no reliable method to estimate the theoretical error bars. A primary objective of the SciDAC project “Building a Universal Nuclear Energy Density Functional (UNEDF)” is to develop a microscopically-based, energy density functional applicable to all nuclei in the form of a generalized Skyrme functional, with theoretical error bars for the different terms in the UNEDF to provide guidance for fine-tuning to data and to give controlled extrapolations away from stability. In this talk, I describe a promising route for achieving these objectives that combine recent advances in chiral effective field theory (EFT) inter-nucleon interactions, renormalization group (RG) techniques for nuclear systems, and nuclear many-body computational methods.

1Supported in part by Department of Energy Grant No. DE-FC02-07ER41457

2:42PM D4.00003 Ab initio no-core shell model with continuum1. PETR NAVRATIL, LLNL — The ab initio no-core shell model (NCSM) is a many-body approach to nuclear structure of light nuclei. The NCSM adopts an effective interaction theory to transform fundamental inter-nucleon interactions into effective interactions for a specified nucleus in a selected harmonic oscillator basis space [1]. The method is capable of predicting nuclear structure from inter-nucleon forces derived from quantum chromodynamics by means of chiral effective field theory [2]. NCSM extensions to the microscopic description of nuclear reactions are now under development. In my talk, I will first discuss our recent calculations of the 4He total photoabsorption cross section using two- and three-nucleon interactions from chiral effective field theory [3]. I will then outline our effort to augment the NCSM by the resonating group method (RGM) technique to develop a new method capable of describing simultaneously both bound states and nuclear reactions on light nuclei [4]. This approach, which preserves translational symmetry and the Pauli principle, will allow us to calculate cross sections of reactions important for astrophysics and describe weakly-bound systems from first principles. I will present our first phase shift results for neutron scattering off 3H, 4He and 7Li and proton scattering off 3He, 4He and 7Be using realistic nucleon-nucleon potentials.


1Prepared by LLNL under Contract DE-AC52-07NA27344. Support from U.S. DOE/SC/NP (Work Proposal Number SCW0498) and the Department of Energy under Grant DE-FC02-07ER41457 is acknowledged.

Saturday, April 12, 2008 1:30PM - 3:18PM –
Session D5 FHP DAP: Triumphs of 20th Century Astrophysics II: We Master the Stars Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade C

1:30PM D5.00001 How We Learned the Stars Run on Nuclear Energy1. MATTHEW STANLEY, Michigan State University — No abstract available.
everyday life and where women are highly involved in the educational process, exposing women to science generates a more scientific literate public. We show this evolution is only possible through diversity of thought and of strategies to approach problems. Therefore, excluding women more than limiting the available opportunity issue. Physics need a greater participation of female researchers in order to survive. Science is changing and it is becoming more interdisciplinary. Passion for physics should be able to make a living and have a successful career in this field. But, the need of gender balance in science, it is not only an equal exclude women with the same abilities of men. But, why should we care about this problem? Why should women be in physics after all? Women that have a women in Latin America leave physics disproportionately with each step of career advance. Moreover, we also show that in many cases the promotion process only that girls are not attracted to go to physics, they few ones that decide to follow the career find difficulties in funding and in promotions. We show that the opportunity to learn about physics and to prepare themselves for a physics career, and others are discouraged from doing so. However, the problems is not into Physics - rather, we need to avoid pushing them out.

3 Supported by the DOE
4 with support by Nathan Currier and Hui Li

2:42PM D5.00003 Standing on the shoulders of giants: Star and planet formation in 2010-2020 - The Kenneth Greisen Lecture. MARK MCCAUGHREAN, University of Exeter — Despite centuries of theoretical hypotheses on the origin of our own Sun and its planets, it is only in the past thirty years that we have begun to develop an empirical, observational picture of how stars and planets are forming today throughout our Galaxy and beyond. Driven largely by the advent of infrared and millimetre astronomy in the 1970s and 1980s, progress in the field has accelerated considerably in the past 10 years through the combination of powerful ground- and space-telescopes covering the X-ray, optical, infrared and millimetre, in addition to considerable improvements in theoretical simulations. In this talk, I shall present an overview of recent observational and theoretical work on the birth and early evolution of stars, brown dwarfs, circumstellar disks, jets, outflows, and planetary systems. In doing so, I shall also identify key problems which future facilities, including the next generation of extremely large ground-based telescopes and the NASA/ESA/CSA James Webb Space Telescope, will play vital roles in helping to unravel over the coming decade.

Saturday, April 12, 2008 1:30PM - 3:18PM — Session D6 FIP FPS: Panel Discussion: International Gender Issues in Physics Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade D

1:30PM D6.00001 Session Introduction. ARTHUR BIENENSTOCK, APS President, Stanford University —

1:35PM D6.00002 Women Physicists in the European Union: how Brussels is moving toward gender equality. GIULIA PANCHERI, INFN Frascati National Laboratories — The policies of the European Union towards gender equality in science occupation will be discussed along three aspects: 1. Current statistics recently published by the EU will be illustrated with some comparison with similar US statistics. The latest recommendations of the Helsinki group will be presented, together with the conclusions of the Women in Science meetings organized by the EU. 2. The implementation of these recommendations will be illustrated by this speaker’s experience both as independent expert for Physics Research Programs for the European Commission for the last 10 years, as well as from the point of view of having been European Coordinator of three Research Networks in Theoretical Physics from 1992 until 2006: the impact of this on young women students will be described. 3. National policies enforced through the Equal Opportunity Committees will be illustrated, with the specific case of the Affirmative Actions of Italian INFN Equal Opportunity Committe and their impact on hiring and promotion of women physicists.

2:01PM D6.00003 Keeping Women in Physics. MEG URRY, Yale University — In the United States women constitute a steadily increasing fraction of scientists in all fields, but progress in Physics is much slower than in other fields. Utilizing the best available talent, including women, is vital to our future prosperity and security. I discuss some of the myths and realities about why the numbers of women are low, and what steps can be taken to improve the situation. I will argue that we do not so much need to, as a colleague recently suggested to me, “pull them by the hair” to get women into Physics – rather, we need to avoid pushing them out.

2:27PM D6.00004 Women in Physics in Latin America: why so few in leadership positions? MARCIA BARBOSA, Universidade Federal do Rio Grande do Sul — Women are greatly under-represented in physics in Latin America. Among all sciences, physics is the field where the increase in the number of women has been particularly slow. Because of this imbalance, many bright young people do not receive the opportunity to learn about physics and to prepare themselves for a physics career, and others are discouraged from doing so. However, the problems is not only that girls are not attracted to go to physics, they few ones that decide to follow the career find difficulties in funding and in promotions. We show that women in Latin America have physics disproportionately with each step of career advance. Moreover, we also show that in many cases the promotion process exclude women with the same abilities of men. But, why should we care about this problem? Why should women be in physics after all? Women that have a passion for physics should be able to make a living and have a successful career in this field. But, the need of gender balance in science, it is not only a equal opportunity issue. Physics need a greater participation of female researchers in order to survive. Science is changing and it is becoming more interdisciplinary. This evolution is only possible through diversity of thought and of strategies to approach problems. Therefore, excluding women more than limiting the available pool of talented people to half of humanity, we are limiting diversity. Finally, in a society where technology is becoming quite important and is governing our everyday life and where women are highly involved in the educational process, exposing women to science generates a more scientific literate public. We show that the implementation of a few affirmative action strategies bring more balance to the promotion process.

2:53PM D6.00005 Panel Discussion —

Saturday, April 12, 2008 1:30PM - 3:18PM — Session D7 FEd: Physics Demonstrations and Strategies for Teaching and Public Outreach Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Rose Garden
1:30PM D7.00001 Youth Exploring Science. DIANE MILLER, Senior Vice President, St. Louis Science Center — This session features Youth Exploring Science (YES), Saint Louis Science Center’s nationally recognized work-based teen development program. In YES, underserved audiences develop interest and understanding in physics through design engineering projects. I will discuss breaking down barriers, helping youth develop skills, and partnering with community organizations, universities and engineering firms.

2:06PM D7.00002 Searching for Truth: The Modeling Method of Instruction1. JAMES CIBULKA, St. Louis Area Physics Teachers — Engagement. Exploration. Student led learning. Higher order thinking. Knowledge that is retained. These are the desired goals of every science educator. The problem for many educators is how to accomplish all of them! I had the great fortune to be introduced to the modeling method of instruction, and it has changed my entire outlook on science and education. The modeling method is a constructivist approach to education that has been successfully implemented across the country; not some pie in the sky dream of education theorists. In modeling instruction, conceptual phenomena are understood by the construction of simple, yet refinable models that build upon one another. In addition, multiple methods for representing the phenomena observed, such as verbal, graphical, algebraic and diagrammatic help students build a rich mental construct. Finally, modeling instruction is research driven. Assessment devices, such as the Force Concept Inventory have proven the efficacy of modeling instruction many times over. This presentation will focus on the how, what and why of modeling instruction, with an emphasis on modeling mechanics.

1With support from the St. Louis Area Physics Teachers and Arizona State University.

2:42PM D7.00003 Active Learning in a Large General Physics Classroom. REBECCA TROUSIL, Washington University in Saint Louis — In 2004, we launched a new calculus-based, introductory physics sequence at Washington University. Designed as an alternative to our traditional lecture-based sequence, the primary objectives for this new course were to actively engage students in the learning process, to significantly strengthen students’ conceptual reasoning skills, to help students develop higher level quantitative problem solving skills necessary for analyzing “real world” problems, and to integrate modern physics into the curriculum. This talk will describe our approach, using The Six Ideas That Shaped Physics text by Thomas Moore, to creating an active learning environment in large classes as well as share our perspective on key elements for success and challenges that we face in the large class environment.

Saturday, April 12, 2008 1:30PM - 2:42PM – Session D8 DAP: Nuclear Astrophysics I Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade A

1:30PM D8.00001 Fusion reactions of neutron rich nuclei in dense matter1. HELBER DUSSAN, CHARLES HOROWITZ — Fusion reactions play a key role in stellar evolution. The astrophysical S factor (or its associated fusion cross section) is important to know reaction rates, study chemical composition and temperature profiles of the star, as well as rate of production of heavy elements. There is not too much experimental information for the low energy fusion cross section of very neutron rich light nuclei. Using a simple barrier penetration model, we calculated the S factor for fusion reactions of neutron rich nuclei (\(^{13}\)O + \(^{24}\)O, \(^{28}\)Ne + \(^{56}\)Ne and \(^{12}\)C + a range of Oxygen isotopes up to \(^{22}\)O). These results provide a lower limit for the fusion cross sections, since the dynamics of the neutron skin of neutron rich nuclei could enhance the penetration of the Coulomb barrier.

1Physics Department and Nuclear Theory Center, Indiana University, Bloomington

1:42PM D8.00002 Study of the \(^{13}\)C(d,n\(_{0,1}\))\(^{14}\)N reaction below \(E_{\text{cm}} = 400\) keV. ERIC CLINTON, M.W. AHMED, S.S. HENSHAW, B.A. PERDUE, Duke/Triangle Universities Nuclear Laboratory, P.N. SEO, TUNL, UConn, and UMass Amherst, S. STAVE, H.R. WELLER, Duke/Triangle Universities Nuclear Laboratory, P.P. MARTEL, University of Massachusetts Amherst, R.H. FRANCE III, Georgia College & State University, R.M. PRIOR, M.C. SPRAKER, North Georgia College & State University — Several poorly understood reactions may contribute to heavy element inhomogeneous nucleosynthesis. Among these reactions, \(^{13}\)C(d,n) has been studied in order to better understand the dynamics of this reaction and the proper way to extrapolate its S-factor. We have made detailed measurements of the angular distributions of the cross sections and the vector analyzing power for the \(n_0\) and the \(n_1\) reaction groups in the \(E_{\text{cm}}\) range from 250 to 400 keV. The atomic beam polarized ion source and the TUNL mini-tandem supplied polarized deuterium beams which struck a thick, enriched \(^{12}\)C target. Nine organic liquid scintillator (BCI-501) neutron detectors were placed at forward and backwards angles. Angular coverage was from 0° to 158° with two detectors at ± 90° to control systematic effects. The data will be compared to the predictions of the direct reaction model.

1:54PM D8.00003 Experimental Tests of Quasiparticle Plasma State Momentum Distribution Predictions in Metal-Hydrides. DAVID KOLTICK, YEONG KIM, Purdue University — An experiment is proposed to search for power law fall off of the momentum distribution of protons in a metal hydride at equilibrium temperatures near the proton interstitial binding energy. A p\(^{-8}\) power law falls off is predicted at scales \(pc/kT > 10\) by Galitskii and Yakimets [1] and Kim and Zubarev [2], using calculations based on quasiparticle plasma state calculations. Similar behavior is observed in high energy hadronic particle distributions at scales \(P_c/m_c \sim 10\) to 100. The experiments scatter a pulsed beam of thermal neutrons from a metal-hydride target at ~1000 K. The experimental signature for power law tails is the uniform angular scattering of the neutron beam to higher energies in the 10 eV and higher energy range. The experiment is designed to search for quasiparticle like behavior to a level of \(10^{-10}\).


2:06PM D8.00004 Effects of nuclear molecular configurations on the astrophysical S-factor for \(^{16}\)O + \(^{16}\)O. ALEXIS DIAZ-TORRES, LEANDRO R. GASQUES, The Australian National University, MICHAEL WIESCHER, JINA, University of Notre Dame, CANBERRA COLLABORATION, JINA COLLABORATION — The impact of nuclear molecular configurations on the astrophysical S-factor for \(^{16}\)O + \(^{16}\)O is investigated within the realistic two-center shell model based on Woods-Saxon potentials. These molecular effects refer to the formation of a neck between the interacting nuclei and the radial dependent collective mass parameter. It is demonstrated that the former is crucial to explain the current experimental data with high accuracy and without any free parameter, whilst in addition the latter predicts a pronounced maximum in the S-factor. In contrast to very recent results by Jiang et al., the S-factor does not decline towards extremely low values as energy decreases.

1This work was supported by the Joint Institute for Nuclear Astrophysics (JINA) through grant NSF PHY 0216783, and by the ARC Discovery grant DP0557065
2:18PM D8.00005 Super-Reflection in Fluid Discs, DAVID TSANG, DONG LAI, Cornell University — In differentially rotating discs with no self-gravity, density waves cannot propagate around the corotation, where the wave pattern rotation speed equals the fluid rotation rate. Waves incident upon the corotation barrier may be super-reflected (commonly referred to as corotation amplifier), but the reflection can be strongly affected by wave absorptions at the corotation resonance/singularity. The sign of the absorption is related to the Rossby wave zone very near the corotation radius. We derive the explicit expressions for the complex reflection and transmission coefficients, taking into account wave absorption at the corotation resonance. We show that depending on the sign of the gradient of the specific vorticity of the disc, \( \zeta = \kappa^2/(2\Omega \Sigma) \) (where \( \Omega \) is the rotation rate, \( \kappa \) is the epicyclic frequency, and \( \Sigma \) is the surface density), the corotation resonance can either enhance or diminish the super-reflectivity, and this can be understood in terms of the location of the Rossby wave zone relative to the corotation radius. Our results provide the explicit conditions (in terms of disc thickness, rotation profile and specific vorticity gradient) for which super-reflection can be achieved. Global overstable disc modes may be possible for discs with super-reflection at the corotation barrier.

2:30PM D8.00006 Gamma Strength Function for \( p \)-process Nucleosynthesis Calculations\(^{1}\), C.T. ANGELL, S. HAMMOND, H.J. KARWOWSKI, UNC and TUNL, E. KWAN, G. RUSEV, A. TONCHEV, Duke and TUNL, J.H. KELLEY, NCSU and TUNL, A. MAKINAGA, H. UTSUNOMIYA, Konan U. — The Gamma Strength Function (GSF) is a key component for calculating photodisintegration reaction rates used for the \( p \)-process modeling. During the \( p \)-process, the nucleus can be thermally excited lowering the effective threshold of photodisintegration. To calculate the reaction rates for excited states, the GSF is taken from an extrapolation of the low-energy tail of the giant dipole resonance. A new technique for determining the GSF using nuclear resonance fluorescence was developed, and measurements were taken for \( ^{142}\text{Nd} \) and \( ^{151}\text{Nd} \) at \( E_{\gamma} = 4 – 9 \text{ MeV} \). The experiment was done at the HIGS facility using a polarimeter consisting of four clover detectors. The results will be presented, and the impact on \( p \)-process calculations will be discussed.

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\(^{1}\)This work was supported in part by DOE Grant No. DE-FG52-06NA26155

Saturday, April 12, 2008 1:30PM - 2:54PM –

Session D10 GGR: Techniques of Numerical Relativity

Hyatt Regency St. Louis Riverfront (formerly Adam's Mark Hotel), St. Louis A

1:30PM D10.00001 Generalized Harmonic Gauge Drivers, LEE LINDBLOM, KEITH D. MATTHEWS, MARK A. SCHEEL, BELA SZILAGYI, Caltech — Recent work on the development of gauge drivers for the generalized harmonic Einstein system will be presented. These new gauge drivers allow a large class of gauge (i.e. coordinate) conditions to be imposed while keeping the generalized harmonic representation of the Einstein system hyperbolic. This class of gauge conditions includes as special cases many of the standard conditions used in numerical relativity: e.g., Bona-Mass slicing, Gamma-drivers, etc. New gauge-controlling boundary conditions will be discussed, along with numerical results that illustrate the effectiveness of this new gauge driver system.

1:42PM D10.00002 Evaluating event horizon finding techniques, MICHAEL COHEN, HARALD PFEIFFER, MARK SCHEEL, Caltech — Event horizons are the defining physical features of black hole spacetimes, and are of considerable interest in studying black hole dynamics. Because of their global nature, event horizons can only be determined after the end of a numerical simulation. Methods of finding event horizons in numerically-generated spacetimes are based on the fact that outgoing null geodesics near an event horizon converge exponentially to the horizon when followed backwards in time. Two existing methods in the literature are discussed: an individual-geodesic method and a level-set method. A third and intermediate method, a surface-flow method, is presented here and implemented numerically alongside the geodesic method. Both single black holes and head-on black hole mergers are explored as test cases. The most robust method for black hole mergers is found to be the individual-geodesic method. The presented techniques are remarkably accurate and allow to track the event-horizon through several quasi-normal oscillations during ringdown of the binary merger.

1:54PM D10.00003 Gauge conditions for numerical relativity, DAVID BROWN, North Carolina State University — The standard 1+log slicing and Gamma driver shift conditions, coupled with the BSSN evolution equations, have been remarkably successful for the binary black hole problem. I will discuss some features of these gauge conditions, why they work and how they might be modified for use with other formulations of the evolution equations.

2:06PM D10.00004 Probing the Binary Black Hole Merger Regime with Scalar Perturbations, ELOISA BENTIVEGNA, DEIRDRE SHOEMAKER, IAN HINDER, FRANK HERRMANN, Pennsylvania State University — We present results obtained by scattering a scalar field off the curved background of a coalescing binary black hole system. A massless scalar field is evolved on a fixed background provided by hypersurfaces generated from a binary black hole inspiral. We show that the scalar field scattered from the merger region exhibits quasinormal ringing once a common apparent horizon surrounds the two black holes. This occurs earlier than the onset of the perturbative regime as measured by the start of the quasinormal ringing in the gravitational waves. We also use the scalar quasinormal frequency to associate a mass and a spin with each hypersurface, and observe the compatibility of this constraint with the horizon mass and spin computed from the dynamical horizon framework.

2:18PM D10.00005 Rapidly spinning binary black hole initial data\(^{1}\), GEOFFREY LOVELACE, ROBERT OWEN, Cornell University, HARALD PFEIFFER, TONY CHU, California Institute of Technology — Numerical simulations of binary-black-hole spacetimes must begin with initial data that both satisfy the constraint equations of general relativity and lead to evolutions with the desired physical properties. We use the extended conformal thin sandwich equations to construct constraint-satisfying binary-black-hole initial data with \( i ) \) nearly-maximal spins aligned with the orbital angular momentum and \( ii ) \) low orbital eccentricities. Specifically, we construct conformally-flat data with dimensionless spins larger than 0.97 and conformally-curved data with spins larger than 0.995.

\(^{1}\)We would like to acknowledge the Sherman Fairchild Foundation, the Brinson Foundation, NSF grants PHY-0601459, PHY-0652995, DMS-0553302, PHY-0652952, DMS-0553677, PHY-0652929, and NASA grants NNG05GG52G and NNG05GG51G.

2:30PM D10.00006 Stability of Iterative Algorithms for Rotating Neutron Stars\(^{1}\), CHARALAMPOS MARKAKIS, University of Wisconsin - Milwaukee, RICHARD H. PRICE, ALAN FARRELL, University of Texas - Brownsville, JOHN L. FRIEDMAN, University of Wisconsin - Milwaukee — Similar methods have been used to construct models of rapidly rotating stars, in Newtonian and relativistic contexts. The choice of method has been based on numerical experiments, which indicate that particular methods converge quickly to a solution, while others diverge. The theory underlying these differences, however, has not been understood. In an attempt to provide a better theoretical understanding, we analytically examine the behavior of different iterative schemes near an exact solution. We find the spectrum of the linearized iteration operator and show for self-consistent field methods that iterative instability corresponds to unstable modes of this operator.

\(^{1}\)NSF Grant No. PHY0503366, NASA Grant No. NNG05GB99G.
2:42PM D10.00007 Numerical Relativity from a Gauge Theory Perspective, WILL FARR, EDMUND BERTSCHINGER, MIT — We present some recent results in a program to discretize the first-order Hilbert-Palatini action for gravity on a simplicial complex as a first step towards computing numerical relativity simulations in a fully gauge-covariant manner. The tetrad and spin connection, the dynamical variables of this theory, discretize naturally on the struts of the complex, and the resulting action is both locally Lorentz and diffeomorphically invariant. Because constraints are associated with these symmetry transformations, the evolutions which result from the Euler-Lagrange procedure are exactly constraint-preserving. This discretization procedure introduces extra degrees of freedom, in much the same way as lattice quantum gauge theory simulations, but we expect theoretically that these will be irrelevant at physical scales in our simulations. We are presently attempting to verify this computationally.

Saturday, April 12, 2008 1:30PM - 3:18PM – Session D11 DPF: Accelerator Neutrinos

1:30PM D11.00001 The SciBooNE neutrino experiment at Fermilab: an overview, HIDE-KAZU TANAKA, Columbia University, SCIBOONE COLLABORATION — The precise measurement of neutrino-nucleus cross-sections in the few GeV energy range is an essential ingredient in the interpretation of neutrino oscillation experiments. For the measurement of the cross-sections, a new experiment, SciBooNE, has been proposed and approved at Fermilab. From June 2007, SciBooNE has started operation and data taking. The experiment is carried out by installing the K2K SciBar detector in the FNAL Booster Neutrino Beamline. The marriage of a high rate, low energy neutrino beam and the fine granularity of SciBar detector is unique for precise measurements of neutrino cross sections since both the beamline and detectors have been built and operated successfully. We will present an overview of the SciBooNE physics program with emphasis on unique elements of the detector systems that allow for identification and measurement of several types of neutrino interactions.

1:42PM D11.00002 Construction of, and Component Testing for, the SciBooNE Muon Range Detector Counters, PAUL NIENTABER, Saint Mary’s University of Minnesota, SCIBOONE COLLABORATION — The Muon Range Detector (MRD) is one of three subsystems comprising the SciBooNE detector currently running in the Booster Neutrino Beamline at Fermilab. The MRD was constructed from recycled plastic scintillator panels and photomultiplier tubes between June 2006 and March 2007. This paper describes the selection, testing, and characterization of the photomultipliers, the testing of the completed counters, the assembly of the MRD itself, and its deployment in the SciBooNE detector enclosure and subsequent operation.

1:54PM D11.00003 Measurements of neutrino charged current interactions at SciBooNE1, YASUHIRO NAKAJIMA, Kyoto University, SCIBOONE COLLABORATION — The SciBooNE experiment (FNAL E954) is designed to measure the neutrino cross sections on carbon in the one GeV range. These measurements are essential for the future neutrino oscillation experiments. Additionally, SciBooNE serves as a near detector for MiniBooNE experiment using the same neutrino beamline by constraining the neutrino fluxes. In this talk, we focus on measurements of inclusive muon neutrino charged current interactions and the neutrino energy spectrum at SciBooNE. The neutrino energy spectrum will be used for the search for muon neutrino disappearance between SciBooNE and MiniBooNE detectors. We have been taking data from the Fermilab booster neutrino beam since June 2007. The preliminary results of the analysis will be reported.

The author is supported by Japan Society for the Promotion of Science.

2:06PM D11.00004 Charged current single charged pion production in SciBooNE, KATSUHIRO HIRAIDE, Kyoto University, SCIBOONE COLLABORATION — The SciBooNE experiment is designed to measure neutrino cross sections on carbon near one GeV, which is important for future neutrino oscillation experiments. This talk focuses on a measurement of the charged current single charged pion production cross section in SciBooNE. If the final state pion is not observed, the event looks like a charged current quasi-elastic interaction. Hence, this interaction mode is the main background to muon neutrino disappearance measurements. The experiment uses a fully active, fine segmented scintillator tracking detector which is called SciBar. Unlike a water Cherenkov detector, the fine granularity of the SciBar detector allows us to detect all charged particles from the vertex. In addition, SciBooNE has the ability to separate the final state pions from protons using dE/dx information. We have been taking data since June 2007. Preliminary results of the analysis on the SciBooNE neutrino data will be presented in this talk.

2:18PM D11.00005 High track multiplicity events in SciBooNE, JOAN CATALA-PEREZ, IFIC (U. Valencia/CSIC) — SciBooNE is a neutrino cross section experiment made to accurately measure neutrino and anti-neutrino cross sections in carbon below 1 GeV neutrino energy. This talk focuses on preliminary results for 3 or more tracks (high track multiplicity) neutrino events. High track multiplicity events in SciBooNE are largely due to charged current neutral pion production (n + n → μ + μ + p + p). Charged current neutral pion production studies are particularly interesting because neutral pion decay to two photons may be reconstructed as an electron neutrino charged current interaction, so it represents a background for electron neutrino appearance in oscillation experiments. The SciBooNE detector gives good particle identification capabilities provided by dE/dx information and fine granularity of the main sub-detector SciBar, reconstruction of electromagnetic energy clusters in the electromagnetic calorimeter 'Electron Catcher' and muon tagging in the Muon Range Detector. SciBooNE data taking started in June 2007. Preliminary results of the analysis on the SciBooNE neutrino data will be presented in this talk.

2:30PM D11.00006 Electron and Gamma Identification for the measurement of the neutral pion cross section in SciBooNE, YOSHINORI KURIMOTO, Kyoto Univ., SCIBOONE COLLABORATION — The SciBooNE experiment is designed to measure neutrino cross sections on carbon in the one GeV region using the Booster Neutrino beam at Fermilab. Neutral pion production is important for future neutrino oscillation experiments, as it is one of the main backgrounds in electron neutrino appearance searches. Because the gamma ray from the neutral pion could be misidentified as an electron and mimic an electron neutrino interaction, it is possible to identify the electron and gamma with the fully active scintillator detector (SciBar) and the spaghetti calorimeter (Electron Catcher). In this talk, I would like to show the performance of the identification of gamma rays using dE/dx and the track shape information in SciBar.

2:42PM D11.00007 Identification of Recoil Proton Tracks for a Neutrino Neutral-Current Elastic Scattering Cross-Section Measurement at SciBooNE, HIDEYUKI TAKEI, Tokyo Institute of Technology, SCIBOONE COLLABORATION — SciBooNE is an experiment for measurement of neutrino-nucleus interaction cross-sections in the few GeV energy region using the FNAL Booster Neutrino Beam. The SciBar detector is a fully active, finely segmented scintillator tracking detector. SciBar's proton/pion separation capability allows proton tracks to be identified, enabling a measurement of neutral-current elastic scattering cross-section. The neutral-current elastic scattering cross-section is sensitive to the axial form factor, and so has bearing on our understanding nucleon spin structure. Proton/pion separation can also reduce one of the backgrounds for charged-current quasi elastic scattering channel. In this talk, I will present the proton identification ability of SciBar.
2:54PM D11.00008 A Study of the NuMI Beam in the SciBooNE Detector#. JAVIER DUARTE, Massachusetts Institute of Technology, SCIBOONE COLLABORATION — The MiniBooNE and SciBooNE experiments, designed to detect neutrino events from the Fermilab Booster, can see events from the NuMI beam, albeit at significant angles. In fact, SciBooNE lies at an off axis angle of 543 mrad, five times greater than MiniBooNE. In this talk, I outline the process of neutrino production in NuMI and describe the off axis simulation of event rates at SciBooNE from NuMI Monte Carlo output. A Pauli-suppression parameter, κ, introduced by the MiniBooNE collaboration in their description of muon neutrino charged current quasi-elastic scattering on Carbon, is applied to see its effect on the prediction of NuMI events at SciBooNE. A geometric acceptance restriction on the events is utilized to single out those leading to the capture of the outgoing muon in SciBar. Finally, the MiniBooNE NuMI trigger timing is summarized for its relevance to a possible SciBooNE NuMI trigger.

#NSF Research Experience for Undergraduates Program

3:06PM D11.00009 ABSTRACT WITHDRAWN —

Saturday, April 12, 2008 1:30PM - 3:18PM —
Session D12 DPF: Dark Matter I
Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis C

1:30PM D12.00001 Determination of the scintillation and ionization yield of nuclear recoils in liquid Xe from XENON10 neutron calibration data. PETER SORENSEN, Brown University, XENON COLLABORATION —

Calorimeter calibration data from the XENON10 experiment is used as a sensitive probe of the Xe scintillation yield (C_{eff}) and ionization yield, for nuclear recoils on liquid Xe. Previous data for the ionization yield — the number of ionization electrons extracted per keV recoil energy (keVr) — do not extend below 25 keVr, while our method is robust to < 3 keVr. Previous data for the scintillation yield vary by ×1.5 at 10 keVr, with limited data at lower energies. We show the most likely C_{eff} curve consistent with the XENON10 neutron calibration data, along with statistical and systematic limits on it’s variation.

1:42PM D12.00002 Background Rejection in the CDMS Dark Matter Search. JEFFREY FILIPPINI, University of California, Berkeley, CDMS COLLABORATION — The Cryogenic Dark Matter Search (CDMS) uses low-temperature semiconductor detectors to search for interactions of weakly interacting massive particles (WIMPs). The CDMS II experiment has recently completed the data analysis of the first data run with its full complement of 30 detectors at Soudan Underground Laboratory. Highly accurate background rejection techniques are required to perform an effective WIMP search at the necessary sensitivities. This talk will focus on the discrimination techniques CDMS uses to suppress backgrounds during this long detector exposure, as well as some directions for future increases in discrimination power.

1:54PM D12.00003 Measurements of the Argon and Neon Scintillation Efficiencies in microCLEAN . DANIEL GASTLER, Boston University Physics Department, DEAP/CLEAN COLLABORATION — I present recent measurements of the nuclear-recoil scintillation efficiency for liquid argon and liquid neon. The scintillation efficiency characterizes the amount of scintillation light produced in a nuclear recoil when compared to that of an electronic recoil of the same energy. These results are from argon and neon runs of the 4 kg noble liquid microCLEAN detector as a part of the DEAP/CLEAN program to detect WIMP dark matter.

2:06PM D12.00004 Pulse Shape Discrimination (PSD) in Liquid Argon . BEI CAI, Queen’s University, Canada, THE DEAP-1 COLLABORATION — Dark Matter Experiment using Argon Pulse-shape discrimination (DEAP) plans to search for WIMPs (Weakly Interacting Massive Particles) through elastic scattering on ^{40}Ar. In this single-phase liquid argon (LAr) experiment discrimination of β and γ backgrounds from the WIMP-induced nuclear recoil signal is achieved by analyzing the pulse shape of scintillation light. A 7-kg low-background LAr scintillation detector was constructed and run at Queen’s University in Canada. A background rejection of 6 × 10^{-8} at 120-240 photo-electrons was achieved.

2:18PM D12.00005 Pulse shape discrimination in liquid argon and liquid neon . HUGH LIPPINCOTT, Yale University, DEAP/CLEAN COLLABORATION — I present results from microCLEAN, a 4 kg noble liquid detector built as part of the DEAP/CLEAN programme to detect dark matter in the form of WIMPs using scintillation light. The sensitivity of these detectors to dark matter is limited by the level of discrimination between electronic and nuclear recoils. Scintillation light is produced in the decay of excimers that can exist in both the singlet and triplet states. Because these states have very different lifetimes, their populations can be easily separated using timing information. Since electronic and nuclear recoils produce different ratios of singlet to triplet molecules, the relative size of the two components can determine what type of event occurred. I present the pulse shape discrimination observed in both liquid argon and liquid neon using various methods, and I predict the sensitivity of a larger liquid argon detector to WIMP dark matter.

2:30PM D12.00006 Sensitivity and backgrounds for the LUX dark matter search. PETER SORENSEN, Brown University, LUX COLLABORATION — The LUX 300 kg two-phase Xe detector aims to detect or exclude dark matter in the form of Weakly Interacting Massive Particles (WIMPs) with scalar cross section (per nucleon) as low as 7 × 10^{-46} cm^{2}. This is equivalent to ~ 0.5 events/100 kg/month in a 100 kg fiducial volume. The LUX design is set to ensure < 1 background event / 10 months live, which could potentially be characterized as a WIMP interaction. Based on above-ground calibrations and data from the XENON10 experiment, LUX expects to reject up to 99.9% of the dominant electron-recoil background at detector threshold (~ 4.5 keVr), with 50% acceptance for nuclear recoils. This level of electron recoil rejection power requires a gamma/beta background event rate of < 8 × 10^{-4} events/keVee/kg/day at threshold — a factor of > 150 above the requisite nuclear recoil background rate. This talk will discuss projected backgrounds and sensitivity of the LUX experiment.

2:42PM D12.00007 Scintillation Output of CF₄ for Dark Matter Detection . ASHER KABOTH, Massachusetts Institute of Technology — Directional detection of dark matter is a powerful way to look for the galactic dark matter halo. The DMTPC collaboration has developed optical readout of time projection chambers, which allow for the direction reconstruction of dark matter nuclear recoils. However, to make this method feasible, the gas in the TPC must have a high scintillation rate. This talk presents a measurement of N_{γ}/N_{β} for a potential gas, CF₄.
2:54PM D12.00008 Measurements of low energy nuclear recoil tracks and its implications for dark matter searches

Christina Hagemann, University of New Mexico—The direction of dark matter particles passing through the solar system is expected to have an anisotropy due to our own motion through the galaxy. The directionality associated with this WIMP wind is one of the strongest signatures for dark matter detection. We show how this directional signal can be measured in our detector which uses low-pressure gas as the target material. Just how well the directionality can be measured is limited by detector resolution and by uncertainties in our knowledge of the energy-loss of low energy nuclear recoils resulting from WIMP interactions. Here we describe preliminary results from ongoing R&D of nuclear recoil tracks in the energy range of interest for WIMP interactions.

2:06PM D12.00009 The Maximum Patch Method for Directional Dark Matter Detection

Shawn Henderson, Massachusetts Institute of Technology—Present and planned dark matter detection experiments search for WIMP-induced nuclear recoils in poorly known background conditions. In this environment, the maximum gap statistical method provides a way of setting more sensitive cross-section upper limits by incorporating known signal information. We give a recipe for the numerical calculation of maximum gap cumulative distribution functions in one dimension, and extend the method to two dimensions for planned directional dark matter detection experiments that will measure both recoil energy and angle.

Saturday, April 12, 2008 1:30PM - 3:06PM — Session D13 DNP: Minisymposium on Nuclear Physics Deep Underground II

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis F

3:00PM D13.00001 Measuring External Sources of Background (R&D) at Homestake

Dongming Mei, University of South Dakota, Yuen-Dat Chan, Lawrence Berkeley National Laboratory, Steve Elliott, Los Alamos National Laboratory, Frederick Gray, Regis University, Christina Keller, Yongchen Sun, University of South Dakota—Measuring external sources of radioactivity at the DUSEL site is the key to success in low-energy neutrino and dark matter (WIMP searches) experiments. Natural radioactivity can be measured using germanium and NaI detectors. Muon-induced neutrons and (a, n) neutrons will be measured utilizing liquid scintillators and germanium detectors through the 72Ge(n, x) reaction. External sources of background, particularly fast neutrons and cosmogenic radioactivity from muon-induced processes, are background matter that must be eliminated for underground experiments in pursuit of double beta decay, WIMPs, and oscillations of low-energy neutrinos. However, muon-induced neutron production rates with heavy elements, such as lead and copper, are not well understood. The discrepancy between the measurements and FLUKA simulations is as large as about a factor of 3. This discrepancy needs be understood for the muon-induced fast neutron production rate in lead and copper, which are the most popular materials for shielding underground experiments. We propose an experiment at 300-ft level to measure the muon-induced fast neutron production rate in different targets.

1:42PM D13.00002 A Low Background Counting Facility for the Deep Underground Science and Engineering Laboratory (DUSEL) at Homestake

Y. Chan, Lawrence Berkeley National Laboratory, A. Alton, Augustana College, C. Keller, Univ. of S. Dakota, K. Lesko, LBNL, D. Mei, Univ. of S. Dakota, R. Mctaggart, S. Dakota State Univ., G. Prior, LBNL, W. Roggenthen, S. Dakota Sch. of Mines & Tech, A. Smith, LBNL, Y. Sun, Univ. of S. Dakota, B. Szczersbinska, Dakota State Univ., Z. Yin, Univ. of S. Dakota—A versatile radioactivity-screening facility is crucial to the DUSEL program, as most of the proposed physics experiments will deal with rare-occurring processes that could be concealed by natural or induced radioactivity from the experimental devices and environment. A State of South Dakota EPSCOR proposal has been submitted to establish a counting facility in the Homestake mine, at the 4,800 ft u.g. level, as part of the early implementation program (SUSEL, Sanford Laboratory). The facility will have dedicated stations for ultra-low level gamma counting, as well as general purpose and high throughput screening stations. The facility will also couple to other underground science initiatives such as underground manufacturing, clean material selection and stockpile etc. The detector resources can be utilized for certain physics measurements as well.

1:54PM D13.00003 A Muon Veto Shielded Cavern for Underground Experiments and Shower Studies

Nathaniel Paskia, Priscilla Cushman, University of Minnesota—The Low Background Counting Facility at the Soudan Underground Lab includes a 33' x 42' x 100' experimental hall lined with proportional tubes from a former proton decay experiment. These tubes have been refurbished and equipped with a modern data acquisition system which records the location and time-stamp of every muon which enters the room. The programmable logic allows a user to run in a customized trigger/veto mode or using offline hit registration. This large-area muon detector has also been used to study the muon angular distribution and resulting cosmogenic hadronic showers at 2100 mwe.

2:06PM D13.00004 TUNL activities at the Kimballton Underground Research Facility

Henning Olling Back, North Carolina State University, Arthur Champagne, REYCO Henning, Padraic Finnerty, University of North Carolina, Werner Tornow, Mary Kidd, James Esteline, Duke University—The Triangle Universities Nuclear Laboratory (TUNL) has taken a large role in the nuclear physics research performed underground at the Kimballton Underground Research Facility operated by Virginia Tech near its campus. Currently two TUNL efforts are underway at Kimballton: 1) double-beta decay/double electron capture experiments to excited final states, which employ high purity germanium detectors to search for signature gammas from the decay of the excited final state and 2) a material assay program that will determine radioactive contamination in detector materials through gamma ray spectroscopy. In this talk I will present the current status of the Kimballton Underground Research Facility and the TUNL activities located there.

2:18PM D13.00005 Systematic study of cosmogenic activation with low background Ge spectroscopy at the Kimballton Underground Research Facility

Padraic Finnerty, University of North Carolina at Chapel Hill, Henning Back, North Carolina State University, REYCO Henning, University of North Carolina at Chapel Hill—A systematic study of the activation rate of materials due to cosmic rays with the aid of low background Ge spectroscopy is proposed. The next generation of underground physics experiments will require unprecedented control and characterization of the intrinsic radioactive isotopes in their detection mediums and construction materials. One such source is the activation of materials via cosmic ray interactions in the upper atmosphere. We propose to activate materials at high altitude, ~14,000 feet above sea level, by utilizing storage space made available to us by the University of Denver’s Meyer-Womble Observatory. Low background Ge spectroscopy will then be performed at the Kimballton Underground Research Facility (KURF), located near the campus of Virginia Tech, to determine the cosmogenic isotope production rates.
2:30PM D13.00006 Neutron-induced backgrounds in Cu and Ge — D.V. PEREPILITSA, LANL & MIT, V.E. GUISEPPE, S.R. ELLIOTT, R.O. NELSON, N. FOTIADES, M. DEVLIN, R.C. HAIGHT, LANL, D.-M. MEI, Z. YIN, U. South Dakota — Measurements of \((n,n')\gamma\) reactions in Cu and Ge are important for understanding neutron-induced background for some underground double beta decay experiments. Neutron-induced gammas are a contribution to background for the next generation of double beta decay experiments, which are designed to reach the sensitivity of the atmospheric neutrino mass scale (45 meV). Measuring and understanding the high-energy neutron excitations of the shielding and detector materials for neutrinoless double beta decay experiments are crucial for interpreting results and establishing shielding requirements. Locationing some specific excited states in various materials represents a significant nuclear structure contribution. Partial \(\gamma\)-ray cross sections were measured using the GEANIE spectrometer containing Cu and Ge (enriched in \(^{76}\text{Ge}\)) targets in a broad-spectrum neutron beam at LANSCE. The cross sections provide useful data for benchmarking Monte Carlo simulation of background events.

2:42PM D13.00007 Neutron-induced Partial Cross Section Measurements on Cu, Ge and Pb at \(E_\gamma = 8\) and 12 MeV for Background Radiation in \(0\nu\beta\beta\) Decay Experiments — E. KWAN, J.H. ESTERLINE, B. FALLIN, C.R. HOWELL, A. HUTCHESON, M.F. KIDD, A. TONCHEV, W. TORNOW, TUNL-Duke, C. ANGELL, H. KARWOWSKI, TUNL-UNC, J. KELLEY, TUNL-NSCU, D. MEI, USD, S. HILDERBRAND, NCCI, D.B. MASTERS, Samford Univ, R.S. PEDRONI, NCATSU, G.J. WEISEL, Penn State Univ-Altoona — The search for the existence of \(0\nu\beta\beta\) decay plays an important role in the uncovering of physics beyond the standard model. The detection of such decay would confirm that neutrinos are Majorana particles. The large lifetimes \((\text{i.e.} \tau_{1/2}(^{76}\text{Ge}) > 10^{25}\text{ y})\) and the corresponding long measuring times require extensive understanding of neutron background induced by neutron interactions with shielding and detector materials. For example, neutron induced \(\gamma\)-ray transitions in Pb and Cu and their escape peaks could interfere with the identification of the 2039 keV signature of \(0\nu\beta\beta\) in the case of \(^{76}\text{Ge}\). Thus, it is necessary to determine the yields from possible background sources. The neutron-induced partial cross sections for \(\gamma\)-ray transions in Cu, enriched \(^{76}\text{Ge}\), and Pb were measured at TUNL using an array of HPGe detectors at \(E_\gamma = 8\) and 12 MeV. The experimental setup and preliminary results will be presented. Supported by DOE Grants DE-FG02-97ER41033 & DE-FG02-97ER41042.

2:54PM D13.00008 High-energy neutron counting deep underground — Raul Hennings-Yeomans, Daniel Akerib, Michael Dragowsky, Matthew Harrison, Case Western Reserve University, Harry Nelson, University of California at Santa Barbara — Dark matter is concentrated in the halos of galaxies, including the Milky Way. If WIMPs make up these halos they can be detected via scattering from atomic nuclei in a terrestrial detector. Experiments that search for WIMPs are one of the critical science drivers for a Deep Underground Science and Engineering Laboratory in the United States. Nuclear recoils from fast neutrons in underground laboratories are one of the most challenging backgrounds to WIMP detection and are estimated using Monte Carlo simulations. We present the design of an instrument capable of benchmarking the Monte Carlos by measuring the high energy >60 MeV muon-induced neutron flux deep underground. The instrument is based on applying Gd-loaded liquids to measure the rate of multiple low-energy neutron events produced in a Pb target and from this measurement to infer the rate of high energy neutron events. We will present design studies of the instrument as well as the current status and prospects for the construction and deployment of the instrument at the deep site.

Saturday, April 12, 2008 1:30PM - 3:18PM – Session D14 DNP: Instrumentation for Low and Medium Energy Nuclear Physics

1:30PM D14.00001 A Dual-Axis Dual-Lateral Position Sensitive Silicon Detector for Charged Particle Detection — Sarah Soisson, Brian Stein, L. May, Texas A&M University, R.Q. Dienhoffer, Oswego State University of New York, M. Janel, Los Alamos National Laboratory, G. Soulititis, Texas A&M University, D.V. Shetty, Texas A&M University, A.L. Keekis, Los Alamos National Laboratory, S. Wuienschel, Z. Kohley, S.J. Yeninello, Texas A&M University — A dual-axis dual-lateral position sensitive silicon detector has been developed for charged particle detection. This type of detector has two conductive strips along opposite edges on each side of the detector. The contacts on the front are perpendicular to those on the back. When an incident particle hits the detector the charge is split between the contacts on each resistive layer. This allows for the total energy to be determined by the summation of either the contacts on the front side or the back side of the detector. The position of each axis can be easily determined using standard formulas such as \(X = (Q_1-Q_2)/(Q_1+Q_2)\), where \(Q\) is the charge collected from one contact. This design allows for position and energy to be determined without the necessity of software correction. Design of the detector, energy and position resolution will be presented.

1:42PM D14.00002 LBAS - A Non-Contact, High Precision Detector Alignment Tool — M. Kilburn, A.M. Rogers, B. Nett, M.S. Wallace, W.G. Lynch, Z.Y. Sun, NSCL MSU — Strip Si detectors provide high precision energy and position information for charged particles. Such information is needed for inverse kinematics experiments or for the reconstruction of particle unbound states of nuclei. In order to fully utilize this precision, it is often necessary to accurately align the strips to the exact beam spot on target and to the direction of the beam. We have developed a Laser Based Alignment System (LBAS) that permits high (sub millimeter) precision measurements of the location of a silicon strip detector without any mechanical contact between detector and measuring device. In this talk, the design will be described and its performance as an alignment tool for several recent strip detector experiments will be discussed.

1This work is supported by the National Science Foundation under Grant Nos. PHY-0606007 and PHY-9977707.

1:54PM D14.00003 MASE (Multiplexed Analog Shaper Electronics): A novel approach to readout of a highly segmented silicon detector array — S. Hudan, J.C. Metelko, M. Hodak, R.T. de Souza, Department of Chemistry and IUCF, Indiana University, A. Alexander, J. Poehlman, Department of Chemistry, Indiana University — A new approach in the signal processing and readout of highly segmented silicon detector arrays is described. The realization of this approach is Multiplexed Analog Shaper Electronics (MASE), an electronic system that allows the effective readout of highly segmented detector arrays when the occupancy in a single event is low. MASE combines the features of good energy resolution with time resolution adequate for random rejection. The MASE system is modular allowing for readout of a sixteen element silicon detector via a single board or a crate configuration of up to 4096 channels. Both the overall design and the performance characteristics of MASE are described.

1Supported by the U.S. Department of Energy under Grant No. DE-FG02-88ER40404
2:06PM D14.00004 Evaluation of Large Area Planar Germanium Double-Sided Strip Detectors
S. GROS, Lawrence Berkeley National Laboratory and Argonne National Laboratory, C.J. (KIM) LISTER, Argonne National Laboratory — Large area segmented planar germanium detectors have many potential uses in basic research as well as in space science, medical imaging and homeland security applications. However, the intrinsic cost and technical complexity of their electronics have hindered progress in developing these position-sensitive gamma ray detectors. In this report we will compare large counters made with the traditional “LEPS” configuration, i.e., with lithium and boron contacts, with more recent detectors using amorphous germanium. We will present a basic series of tests which allow the performance of the counters to be evaluated and compared. In addition, TMC resolution and timing tests are necessary, but far from sufficient, conditions for identifying a superior detector. Charge loss, charge sharing, and cross talk all play significant roles in detector performance. These issues become critical when exploiting the detectors capability for reconstructing “multi-hit” events in gamma ray tracking or polarization experiments. This research was supported by the DOE Office of Nuclear Physics under contract DE-AC02-06CH11357.

2:18PM D14.00005 Determination of the Spectral and Intensity Distribution of the Mono-Energetic Gamma-Ray Beam at HiS: Using a Large Volume HPGe Detector
G. BONBETTA, N. DELOIS, J. DE LA RUE, C. DUMAS, J. KUEHNE, B. LAMBERT, D. MARECHAL, S. PICON, G. ROSSET, R. THOMAS, F. TIONCHEV, ANTHONY HUTCHESON, ELAINE KWAN, WERNER TORNOW, CHRIS ANGELL, HUGON KARWOWSKI, JOHN KELLEY, CHANCHANG SUN, YING WU — The High-Intensity Gamma-ray Source facility (HiS) provides γ-ray beams with small energy spread (1 – 3 %) suitable for investigating the response of nuclides to dipole radiation. Nuclear resonance fluorescence experiments require precise knowledge of the intensity and the spectral distribution of the incident γ-ray beam in order to deduce the scattering cross section. We present a method for determining the energy spectrum of the γ-ray beam using a large volume HPGe detector. We monitor the γ-ray flux during in-beam experiments by measuring the intensity of γ-rays scattered through small angles from a copper plate. The results are compared to flux determinations derived from strong narrow resonances with known scattering cross sections in various nuclides in γ-ray scattering experiments.

3This work was supported in part by USDOE Grants No. DE-FG02-97ER41043, DE-FG02-97ER41041 and DE-FG02-97ER41042.

2:30PM D14.00006 Design and Performance of Neutron Detector N*:
IWONA PAWEŁCZAK, JAN TÖKE, YUN-TSE TSAI, W. UDO SCHRODER, University of Rochester Departments of Chemistry and Physics — The design of the N* Detector (“Neutron Sandwich Transmuter/Activation-γ Radiator”) and its response to neutrons are described. The N* is a high efficiency plastic-scintillation detector with sensitivity to neutrons in a wide energy range and multi-hit information. The device consists of a stack of plastic scintillator slabs (Saint Gobain BC-408) alternating with thin radiator films (PDMS), which are loaded with 0.5% (by weight) of Gd. The stack is coupled to a photomultiplier tube. The scintillator plays the dual role of a neutron moderator and a γ-ray detector. Scintillation light is produced in response to both, the prompt moderation process and the delayed emission of Gd-capture γ-rays. The design and experimental results with respect to light response, energy and time resolution, and detection efficiency will be discussed, along with comparison to Monte Carlo simulations.

1Supported by the U.S. Department of Energy Grant No. DE-FG02-88ER40414.

2:42PM D14.00007 The commissioning of the O-TPC at TUNL
P.-N. SEO, M.W. AHMED, E.R. CLINTON, C.R. HOWELL, S.C. STEAVE, H.R. WELLER, TUNL, A.H. YOUNG, M. GAI, U. Conn., B. BROMBERGER, V. DANGENDORF, K. TITTELMEIER, PTB, Braunschweig — We are commissioning the Optical Readout Time Projection Chamber (O-TPC) that will be used in an experiment at the HiS facility at TUNL for studying oxygen formation during stellar helium burning by studying the time reversed \( ^{14}O(^{16}O,^{12}C)C \) reaction. The initial calibration of the O-TPC was carried out at the LNS at Avery Point with a CMAC based data acquisition system. The tests at TUNL used a VME based data acquisition system that also controls a CCD camera. Under stable conditions an energy resolution as good as 2.6% was measured for the charge signal and single and double tracks of alpha particles from a \(^{146}\text{Gd}\) source were recorded in the CCD camera. These tracks were analyzed using an automated pattern recognition algorithm that allows us to extract that track centroid (from which the scattering angle is deduced) as well as DE/DX along the track. The azimuthal angle of the track is deduced from the Time Projection. The O-TPC is found to be ready for accepting beams from the HiS facility.

2:54PM D14.00008 Laser-Induced Fluorescence Detection of He\(_2\) Molecules in Superfluid Helium as a New Detector Technology
W.G. RELLERT, S.B. CAHN, A. CURIONI, J.A. NIKKEL, J.D. WRIGHT, D.N. MCKINSEY, Yale University — Ionizing radiation events in liquid helium result in the copious production of long-lived He\(_2\) triplet molecules \((\tau = 13 \text{s})\). We present results on the detection and imaging of these molecules in superfluid helium using laser-induced fluorescence. We show that a laser tuned to 905 nm can excite the molecules via a two photon transition which results in the emission of detectable red photons at 640 nm. Upon deexcitation, molecules return to their ground state, and can be excited again. This cycling transition can be repeated many times during the lifetime of the molecule, potentially enough times to allow for single molecule detection. We present emission and absorption spectra and show images obtained using an intensified CCD camera. This technique gives rise to a new detector technology with applications in the detection of gamma rays, WIMP\(^{-}\) dark matter, and ultracold neutrons.

1This work was supported by the Defense Threat Reduction Agency under Grant No. DTRA01-03-D-0009-0011.

3:06PM D14.00009 Monte Carlo studies of \(\beta\)-detector efficiency with GEANT4 for precise \(\beta^+\)-branching-ratio experiments
V.V. GOLOVKO, V.E. IACOB, J.C. HARDY, Cyclotron Institute, Texas A&M University — We previously reported Monte Carlo (MC) studies of the efficiency of a 1-mm-thick plastic detector to few-MeV electrons with various programs: Ge4, EGSnrc and Penelope. The simulated results were also compared with measured data from standard conversion-electron sources: \(^{133}\text{Ba},^{137}\text{Cs}\) and \(^{203}\text{Bi}\). [1] These studies were part of our program to test the Electroweak Standard Model via precise measurements of lifetimes, branching ratios and Q-values of superallowed \(0^{-} \rightarrow 0^{-}\) nuclear transitions [2], which in turn yield the value of the up-down quark-mixing element of the Cabibbo-Kobayashi-Maskava (CKM) matrix. The MC studies of the \(\beta\)-detector efficiency are important for the measurement of precise \(\beta^+\)-branching-ratios since there is a slight difference in the efficiency of the \(\beta\)-detector for different \(\beta\)-branches. This has an additional affect on the number of observed \(\beta \rightarrow \gamma\) coincidences over and above the well known efficiency of our \(\gamma\)-ray detector. We report here an extension of the comparison between MC calculations and experiment to a \(^{60}\text{Co}\) \(\beta\)-source, and a study of the influence of peripheral objects on the \(\beta\)-detector efficiency. [1] V.V. Golovko et. al. BAPS 59, no 6, p. DH4 83, 2006; BAPS 52, no 3, p. C16 53, 2007; BAPS 52, no 9, p. EH8 83, 2007. [2] J.C. Hardy and I.S. Towner. PRC, 71(5):055501, 2005.

Saturday, April 12, 2008 1:30PM - 3:06PM
Session D15 DNP: Electroweak Interactions
Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis H
1:30PM D15.00001 What if \( G_F^b \) is Zero? Implications for \( G_M^s \) and \( G_A^s \). JOHN SCHAUB, STEPHEN PATE, Physics Department, New Mexico State University — Because strange quarks are the lightest quarks present in nucleons, via only vacuum fluctuations, studying their activities in nucleons gives us insight to the vacuum’s effects on nucleons properties. These contributions can be accessed through electroweak interactions—in particular through parity-violating e\( n \) and \( n \nu \) elastic scattering. Recent data from parity-violating e\( n \) elastic scattering (HAPPEX, PVA4) suggests that the strange contribution to the proton electric form factor, \( G_E^p \), may be nearly zero in the range \( 0 < Q^2 < 1 \text{ GeV}^2 \). We assume that \( G_M^p \) is small and use existing \( n \nu \) data to explore the consequences for \( G_M^s \) and \( G_A^s \).

1:42PM D15.00002 A New Precision Measurement of the Lifetime of \( ^{19}\text{Ne} \). LEAH BROUSSARD, Duke U & TUNL, ROBERT PATTIE, HENNING BACK, ALBERT YOUNG, NCSU & TUNL, UMANKANT DAMMALAPATI, SUBHDEEP DE, PETER DENDOOVER, OTTO DERMOIS, LEO HUISMAN, KLAUS JUNGMANN, ARAN MOL, C. GÉRÔ ONDERWATER, ANDREY ROGACHEVSKIY, MOSLEH SOHANI, EMIL TRAYKOV, LORENZ WILLMANN, HANS WILSCHUT, KVI — The mixed \( \frac{1}{2}^- \rightarrow \frac{1}{2}^+ \) decay of \( ^{19}\text{Ne} \) is an important system for studies of the weak interaction. A measurement of the lifetime of this decay at the 10\(^{-10}\) level combined with the measured value of the \( \beta \)-asymmetry enables a determination of \( V_{ud} \) that rivals the precision obtained from other \( \nu \) superallowed Fermi beta decays. The lifetime is currently known to a precision of about 0.08\%, and by utilizing the unique capabilities of the Trapped Radioactive Isotopes: \( \mu \)icro-laboratories for fundamental Physics (TRI\( \mu \)P) facility at the Kernfysisch Versneller Instituut (KVI), we can improve this precision by up to a factor of three. We describe recent progress towards a high-precision lifetime measurement and present preliminary results.

1:54PM D15.00003 Improved \( \beta \) Decay Branching Ratios. V.E. IACOB, J.C. HARDY, V. GOLOVKO, Cyclotron Institute, Texas A&M University — The work we report here aims at increasing the precision possible in the measurement of branching ratios for superallowed \( \beta^+ \) decays. Such highly accurate values are essential in generating precise \( f \)-values for \( 0^+ \rightarrow 0^+ \) decays, which can then be used to test the Standard Model via the unitarity of the Cabibbo-Kobayashi-Maskawa matrix [1]. The required precision is \( \sim 0.1\% \) or better. While this limit was already achieved in the case of \( ^{34}\text{Ar} \) [2], it would have been very difficult, if not impossible, to achieve it for other \( \beta^+ \) decays without an upgrade to our acquisition and data-reduction systems. We have thus improved the controls over all the key elements in our experimental set-up: we now have direct control over the dead-time for the singles and coincidence channels and <0.1 mm control over the source-detector distance. In addition, we have extensively studied the efficiency of the \( \beta \)-detector with source-measurements tested against various Monte Carlo programs [3]. We have tested our new acquisition set-up on \( ^{60}\text{Co} \) and \( ^{22}\text{Na} \) (\( \beta^- \) and \( \beta^+ \) emitters respectively) to validate our new methods. Preliminary results on the two sources are statistically consistent with the expected values. An \( ^{34}\text{Ar} \) decay experiment using the new experimental configuration has already been performed and is currently analyzed. [1] J.C. Hardy and I.S. Towner, PRC 71, 055501 (2005) [2] V. Iacob et al., BAPS 52(3)B16; BAPS 52(9)F3 [3] V. Golovko et al., BAPS 52(9)DH4; this BAPS

2:06PM D15.00004 MuCap: From first results to final precision on determining \( g_\mu \). BRENDAN KIBURG, The University of Illinois at Urbana-Champaign, MUCAp COLLABORATION — The MuCap collaboration recently reported the muon capture rate from the hyperfine singlet ground state of the \( ^6\text{Li} \) atom to be \( \lambda_\mu = 725 \pm 17.4 \text{ s}^{-1} \). The extracted nucleon induced pseudoscalar form factor, \( g_\mu \), is \( 7.3 \pm 1.1 \). Subsequent runs contain 10 times more data and significant improvements have been made to the experimental apparatus. The aim is to reduce the final uncertainty of \( \lambda_\mu \) by a factor of three. The isotopic and chemical impurities in the protium target have been greatly reduced and an electrostatic kicker has been used to increase the effective data rate threefold. The experiment was upgraded with neutron detectors and full analog recording using custom built FADC modules for several critical detectors. I will present a description of the experimental upgrades and the status of the analysis, which with new data will reduce the overall uncertainty of \( g_\mu \) to \( 7\% \).

2:18PM D15.00005 Nuclear Transparency of Kaons (K+) . MR NURUZZAMAN, Mississippi State University, JLAB E01107 COLLABORATION — Quantum Chromo Dynamics (QCD) is the fundamental theory of the strong force. The transition from nucleons and mesons to the quarks and gluons of QCD can be studied by looking for the onset of phenomena predicted by QCD, such as Color Transparency (CT). CT is the disappearance of final (initial) state interactions for hadrons produced in exclusive processes at high momentum transfers. An experiment to measure the transparency of pions, in search of CT was completed in Dec 2004 at JLab in Hall C. The same set of data also has a considerable sample of kaons that can be used to study the transparency of kaons. The pion analysis via electro-production has not been studied before and will provide useful information regarding the nature of the transition from quarks to hadrons. In addition, this data will help us investigate the anomalous strangeness transparency reported for kaon-nucleus scattering data. We will extract the kaon transparency by comparing the electro-production of kaons from various nuclear targets to electro-production from hydrogen which is similar to the technique used to measure pion transparency. Preliminary results from this analysis will be presented.

2:30PM D15.00006 ABSTRACT WITHDRAWN —

2:42PM D15.00007 Preliminary results from Jefferson Lab HKS experiment . LULIN YUAN, Hampton University, JLAB HKS COLLABORATION — Jefferson Lab hypernuclear program aims to obtain high resolution hypernuclear spectroscopy in a wide mass region by utilizing high precision electron beam. The second experiment in the program, JLab HKS experiment, which was carried out in 2005, employed an on-target Splitter magnet to detect both scattered \( \pi^- \) and \( K^+ \) at very forward angles in order to increase hypernuclear yield. The preliminary results from this experiment has demonstrated the ability of this experimental program to obtain high resolution, high statistics spectroscopy. A specially designed calibration procedure for the spectrometer system has enabled us to further improve the energy resolution of the spectra. In this talk, I will present the current updated spectra of \( ^{12}\text{B}, ^{26}\text{Al}, ^{3}\text{He} \). The experimental setup and spectrometer calibration procedure will also be described.

2:54PM D15.00008 Finite-Q^2 Corrections to Parity-Violating DIS. TIMOTHY HOBBS, The University of Chicago, WALLY MELNITCHOUK, T.JNAF — Parity-violating deep inelastic scattering (PVDIS) has been proposed as an important new tool to extract the flavor and isospin dependence of parton distributions in the nucleon. We discuss finite-Q^2 effects in PVDIS asymmetries arising from subleading kinematical corrections and longitudinal contributions to the e\( Z \) interference. For the proton, these need to be accounted for when extracting the d/u ratio at large \( x \). For the deuteron, the finite-Q^2 corrections can distort the effects of charge symmetry violation in parton distributions, or signals for physics beyond the standard model. We further explore the dependence of PVDIS asymmetries for polarized targets on the u and d helicity distributions at large \( x \).

Saturday, April 12, 2008 2:00PM - 4:05PM —

Session 7HE HEDP HEDLA: Shocks in the Universe and Laboratory

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade F
2:00PM 7HE.00001 Shock Waves in the Large Scale Structure of the Universe. DONGSU RYU, Chungnam National University — Cosmological shock waves result from the supersonic flow motions induced by hierarchical formation of nonlinear structures in the universe. Like most astrophysical shocks, they are collisionless shocks which form in the tenuous intergalactic plasma via collective electromagnetic interactions between particles and electromagnetic fields. The gravitational energy released during the structure formation is transferred by these shocks to the intergalactic gas in several different forms: in addition to the gas entropy, cosmic rays are produced via diffusive shock acceleration, magnetic fields are generated via the Biermann battery mechanism and Weibel instability, and vorticity is generated at curved shocks. Here I review the properties, roles, and consequences of the shock waves in the context of the large scale structure of the universe.

2:25PM 7HE.00002 Effects of Pre-Existing Upstream Turbulence on Magnetic Fields and Particle Acceleration at Astrophysical Shocks. J. R. JOKIPII, University of Arizona — We consider effects of pre-existing, large-scale turbulence upstream of a shock on the magnetic field and the acceleration of charged particles. Turbulent magnetic-field-line mixing plays a large role in particle transport. Also, turbulent density fluctuations upstream of the shock have a large effect on the magnetic field downstream (Giacalone and Jokipii, Ap. J., 633, L41, 2007). For high Alfvén-Mach-number shocks, the downstream magnetic field is amplified considerably above the value obtained from the shock jump conditions. These effects may provide a robust and natural understanding of recent observations at astrophysical shocks. The magnetic-field amplification implied by our simulations should exceed factors of 100, consistent with observed X-rays from supernova remnants, which require magnetic fields of 100µG. These are much larger than expected from the shock jump conditions. In this case, the upstream field is not amplified, so cosmic-rays with energies approaching the “knee” in the spectrum require rapid acceleration, which can occur at the quasi-perpendicular part of the supernova blast wave, where the turbulent field-line mixing plays a large role. Further, recent observations by the Voyager 1 spacecraft downstream of the heliospheric termination shock show that the magnetic field has large magnitude fluctuations. We suggest that these and other effects of pre-existing turbulence play an important role in many astrophysical and heliospheric shocks.

2:50PM 7HE.00003 Collisionless Shocks and Particle Acceleration. TONY BELL, University of Oxford — In recent years, cosmic ray physics has made a transition from being a semi-detached part of astrophysics to become an essential part of observational astronomy. This increased prominence is due to the development of gamma-ray and x-ray astronomy which detect emission produced by TeV particles, the recognition that cosmic rays are probably responsible for the observed large magnetic fields accompanying shocks, the deduction of highly relativistic motion in gamma-ray bursts connected with supernovae, and the Auger project to identify the source of the very highest energy cosmic rays. Observational developments constrain the theory of cosmic-ray acceleration by shocks and encourage consideration of acceleration in a wider range of environments. A non-resonant interaction between cosmic rays and the thermal plasma (Bell, MNRS 353 550 (2004)) generates large magnetic fields and increases the maximum energy to which cosmic rays can be accelerated. This resolves important issues surrounding cosmic-ray acceleration and it also points to the possibility that forces exerted by cosmic rays may be dynamically important on a macroscopic scale with consequences for supernovae and gamma-ray bursts. Laboratory investigation may supplement observation and theory in this intriguing intersection of astrophysics and plasma physics.

3:15PM 7HE.00004 Turbulent shock processing, relevant to shock-cloud interactions1. J. FREDDY HANSEN, Lawrence Livermore National Laboratory, Livermore CA 94550, USA — The evolution of interstellar clouds following the passage of a supernova shock is an important astrophysical phenomenon; the shock passage may trigger star formation and the post-shock flow surrounding the clouds will strip them of material, effectively limiting cloud life times. Experiments conducted at the Omega laser attempt to (a) quantify the mass-stripping of a single cloud, and (b) simulate the effects of nearby clouds interacting with each other. A strong shock is driven (using 5 kJ of the 30 kJ Omega laser) into a cylinder filled with low-density foam with embedded 120 µm Al spheres simulating interstellar clouds. The density ratio between Al and foam is ~ 9. Material is continuously being stripped from a cloud at a rate which is inconsistent with laminar models for mass-stripping; the cloud is fully stripped by 80 ns-100 ns, ten times faster than the laminar model. A new model for turbulent mass-stripping is developed [1,2] that agrees with the observed rate and which should scale to astrophysical conditions. Two interacting spherical clouds are observed to turn their upstream sections to face each other, a result that is completely opposite of earlier work [3] on two interacting cylinders. The difference between these two cases is explained by the relative strength of shocks reflected from the clouds. [1] J.F. Hansen et al, “Experiment on the Mass-Stripping of an Interstellar Cloud Following Shock Passage,” Astrophys. J. 662, 379-388 (2007). [2] J.F. Hansen et al, “Experiment on the mass-stripping of an interstellar cloud in a high Mach number post-shock flow,” Phys. Plasmas 14, 056505 (2007). [3] C. Tomkins et al, “A quantitative study of the interaction of two Richtmyer-Meshkov-unstable gas cylinders,” Phys. Fluids. 15, 986 (2003).

3:40PM 7HE.00005 Recent progress on particle acceleration at supernova remnants. RYO YAMAZAKI, Hiroshima University — Supernova remnants in the Milky Way galaxy are most promising accelerators of cosmic rays showering on the Earth. I will review current unresolved problems and recent progress of both observational and theoretical works on the cosmic-ray acceleration at supernova remnants. I will focus on the fact that recent X-ray and very-high-energy gamma-ray observations tell us important information on this issue, especially on acceleration efficiency, evidence for proton acceleration, and so on.

Saturday, April 12, 2008 3:30PM - 5:18PM –
Session E2 DPF: Prize Winners Hyatt Regency St. Louis Riverfront (formerly Adam039;s s Mark Hotel), St. Louis D

3:30PM E2.00001 W.K.H. Panofsky Prize Talk: The Utah Fly’s Eye Detector1. GEORGE CASSIDAY, University of Utah — In 1963, John Linsley detected a 100 EeV extensive air shower (EAS) at Volcano Ranch, New Mexico. Greisen, Kuzmin and Zatsepin realized that the existence of cosmic rays exceeding 60 EeV (UHCR) was surprising since inverse photoproduction off the 3 K CMB should severely degrade their intensity, now called the GKZ cutoff. Greisen suggested that UHCR should generate enough air fluorescence light that they might be detected within an area exceeding 1000 km². The Utah group proposed such a detector, the Fly’s Eye, which could realize Greisen’s suggestion and detect UHCR at a greater rate than had been achieved by more conventional means. The expectation was to identify the primary particles and demonstrate that if they existed in significant number then the sources must be “local,” consistent with the prediction of GKZ. The detection of UHCR with a prototype Fly’s Eye detector was carried out in coincidence with Linsley’s Volcano Ranch array. Subsequently, the Utah group built two all sky detectors, Fly’s Eye I and II, which operated together for many years in the remote western Utah desert. The design, construction, and operational characteristics of the detector and some of its results will be presented in the talk.

1National Science Foundation
life?" Thus, particularly for those who believe that research should serve society, the satisfactions of an industrial research career are deep and varied.

Difficult. But, as I will discuss, life in industrial research is constantly offering opportunities to provide new answers to the question, "What should I do with my life?" Thus, particularly for those who believe that research should serve society, the satisfactions of an industrial research career are deep and varied.

The company. Viewed as a problem in career tactics in a constantly changing technical, business, and organizational landscape, it might seem overwhelmingly difficult. But, as I will discuss, life in industrial research is constantly offering opportunities to provide new answers to the question, "What should I do with my life?"

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3:30PM E3.00001 Accelerator Physics Related to Rare Isotope Beams1, PETER OSTROUMOV, Argonne National Laboratory — Extensive analysis of the existing data and theoretical models has suggested that the highest yield for a wide range of rare isotopes available for experiments can be obtained by using two accelerators: a heavy-ion driver and a post-accelerator for re-acceleration of radioisotopes. The superconducting driver linac provides the primary, 400 kV, stable-ion beams in the energy range from 580 MeV for protons to 200 MeV/u for uranium required to produce the radioisotopes. To overcome intensity limitations from the most advanced ECR ion sources, the driver linac is designed for the simultaneous acceleration of two charge-states of uranium ions in the front-end and 5 charge states of uranium ions after the liquid lithium stripper. The most efficient production mechanisms for slow radioactive ions produce these ions in 1+ or 2+ charge states. The post-accelerator must, therefore, be able to accept such low charge-to-mass ratio ions. However, this option results in an expensive post-accelerator. One approach is to increase the charge state of the ions before acceleration via a charge booster stage. The intensity of rare isotope beams can be enhanced by the acceleration of multiple charge state beams.

1This work was supported by the U.S. Department of Energy, Office of Nuclear Physics, under Contract No. DE-AC-02-06CH11357.

4:06PM E3.00002 Concepts for High Luminosity Electron-Ion Colliders: Developments and Current Status, CHRISTOPH TSCHALAEER, MIT — Three concepts for a polarized, high luminosity (~10^31-10^32 cm^-2 sec^-1) electron-ion collider (EIC) of 50 ~ 150 GeV center-of-mass energy are currently studied in the US: A conventional ring-ring version and a more ambitious linac-ring version of eRHIC collides electrons from a storage ring or in an energy recovery linac with the hadron beams of RHIC. A more futuristic concept involves colliding figure ~ 100 MeV electron and hadron storage rings using electrons from CEBAF involving very high bunch collision rings to achieve maximal luminosity. First ideas for an electron-ion collider at the LHC (LHeC) are presented.

4:42PM E3.00003 SCRF and Other Technological/Conceptual Developments with Applications to Nuclear Physics Facilities, SWAPAN CHATTOPADHYAY, Cockcroft Institute — We highlight the recent developments in the science and technology of microwave superconducting radio-frequency cavities, novel concepts in particle colliders and other related technologies. This will be followed by an overview of their potential applications to high energy, high luminosity fixed target accelerators or colliders for various nuclear physics applications of electron-hadron, electron-nucleus and electron-heavy ion collisions. These facilities, designed to explore the dynamics of quarks and gluons deep inside a nucleon, could materialize at several laboratories around the world such as a possible Large electron-Hadron Collider (LHeC) at CERN, a possible electron-ion collider at BNL or Jefferson Lab, the planned 12 GeV upgrade of CEBAF and future rare isotope facilities.

Saturday, April 12, 2008 3:30PM - 5:18PM —
Session E4 FGSA: Panel Discussion: Non-traditional Careers for Physicists

3:30PM E4.00001 Scientific Careers in Public Policy, DON ENGEL, Senior Science Policy Fellow, APS Washington Office — Congress is built to respond to the will of its constituents. Representatives and their staffs are awash in information. If scientists do not communicate regularly and effectively with Congress, policies requiring sound scientific underpinnings will be ill-crafted. As a panelist, I will represent scientific careers in public policy, and will also address how civic engagement can be woven into the fabric of any career path.

3:40PM E4.00002 Life as a PRL Editor, ROBERT GARISTO, Associate Editor, Physical Review Letters — I will briefly describe my experiences, from getting a PhD in theoretical particle physics and doing a postdoc, to becoming an editor for Physical Review Letters. Then I'll give you a sense of what the PRL job is like.

3:50PM E4.00003 ABSTRACT WITHDRAWN —

4:00PM E4.00004 What I've Learned and Unlearned as a Physical Scientist in the Life Science Industry, DAVID MORGENSTERN, Associate Fellow, Process Technology, Monsanto Co. — I joined Monsanto in 1996 with a Ph.D. in Physical Chemistry and a background in photochemistry and supercritical fluids, just as the company was exiting the chemical business. Since then, I experienced a merger into a pharmaceutical company (Pharmacia) and a spinoff into a purely agricultural company, focused on Biotech and Crop Protection. Change of this kind is typical in industrial research. I have found it to be a continuing challenge to decide when to adapt and when to focus on marketing the expertise that I brought into the company. Viewed as a problem in career tactics in a constantly changing technical, business, and organizational landscape, it might seem overwhelmingly difficult. But, as I will discuss, life in industrial research is constantly offering opportunities to provide new answers to the question, "What should I do with my life?"

Thus, particularly for those who believe that research should serve society, the satisfactions of an industrial research career are deep and varied.
Due to the unique ground state spin structure of the sensitively on the nuclear physics included in the models. Center of the white dwarf, and the subsequent evolution of the fireball sensitively depends on the relative size of the ignition point and its location. I will describe present an overview of proposed mechanisms for the explosion and describe the requisite physics for each. Many scenarios invoke a deflagration born near the center of the white dwarf, and the subsequent evolution of the fireball sensitively depends on the relative size of the ignition point and its location. I will describe the flame and ash nuclear energetics and demonstrate that for the case of rising bubbles, featured in some explosion scenarios, the bubble evolution depends sensitively on the nuclear physics included in the models.

Supernovae are one class of bright stellar explosions that are distinguished by a lack of hydrogen in the observed spectra. The most widely accepted scenario is a thermonuclear runaway occurring in a C/O white dwarf that has gained mass from a companion star. The details of the explosion mechanism are incompletely understood, and at present there are competing models that differ in the details of the initial conditions and the nature of the thermonuclear burning. I will present an overview of proposed mechanisms for the explosion and describe the requisite physics for each. Many scenarios invoke a deflagration born near the center of the white dwarf, and the subsequent evolution of the fireball sensitively depends on the relative size of the ignition point and its location. I will describe the flame and ash nuclear energetics and demonstrate that for the case of rising bubbles, featured in some explosion scenarios, the bubble evolution depends sensitively on the nuclear physics included in the models.

A brief overview of physicists activities at Boeing. Dr. Stan Lawton is a Technical Fellow in Materials, Processes and Physics in Boeing’s Phantom Works RD component. In thirty years of aerospace research at McDonnell-Douglas and Boeing, he has worked in areas as diverse as high-energy laser development, materials synthesis and combustion chemistry. Dr. Lawton will briefly discuss his career and some physics-related activities at Boeing.

Saturday, April 12, 2008 3:30PM - 5:18PM
Session E5 DNP GHP: Computational Nuclear Physics

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade C

3:30PM E5.00001 Hadron Physics Computations in Lattice QCD COLIN MORNINGSTAR, Carnegie Mellon University — Progress in extracting excited-state baryon and mesons masses in lattice QCD using large sets of spatially-extended operators is presented. The use of stochastic estimates of all-to-all quark propagators with variance reduction techniques is described. Such techniques are crucial for incorporating multi-hadron operators into the correlation matrices. The current status of form factor and structure function computations is also reviewed.

4:06PM E5.00002 Modeling Type Ia Supernova Explosions ALAN CALDER, Stony Brook University — Type Ia Supernovae are one class of bright stellar explosions that are distinguished by a lack of hydrogen in the observed spectra. The most widely accepted scenario is a thermonuclear runaway occurring in a C/O white dwarf that has gained mass from a companion star. The details of the explosion mechanism are incompletely understood, and at present there are competing models that differ in the details of the initial conditions and the nature of the thermonuclear burning. I will present an overview of proposed mechanisms for the explosion and describe the requisite physics for each. Many scenarios invoke a deflagration born near the center of the white dwarf, and the subsequent evolution of the fireball sensitively depends on the relative size of the ignition point and its location. I will describe the flame and ash nuclear energetics and demonstrate that for the case of rising bubbles, featured in some explosion scenarios, the bubble evolution depends sensitively on the nuclear physics included in the models.

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4:42PM E5.00003 Nucleon structure study using a polarized 3He target HAIYAN GAO, Duke University — Due to the unique ground state spin structure of the 3He nucleus, polarized 3He nuclear targets have been used widely in experiments ranging from measurements of the neutron electric and magnetic form factors to the study of the neutron spin structure. In this talk, I will highlight some of the recent results and also discuss upcoming experiments. Particularly, I will discuss the upcoming neutron transverse momentum asymmetry experiment in Hall A at Jefferson Lab using a vertically polarized 3He target and the planned polarization Compton scattering experiment from a polarized 3He target at the H1 facility located at the Duke Free Electron Laser Laboratory using the circularly polarized photons. All these experiments benefit greatly from recent developments in calculating the three-body system. The work is supported in part by a U.S. Department of Energy grant DE-FG02-03ER41231.

Saturday, April 12, 2008 3:30PM - 5:18PM
Session E5 DNP GHP: Computational Nuclear Physics

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade D

3:30PM E6.00001 Matter under Extreme Conditions: Advances Based on Static Compression RUSSELL HEMLEY, Geophysical Laboratory, Carnegie Institution of Washington — Current technological advances make it possible to perform experiments on materials at static or sustained conditions to multimegabar pressures (several hundred GPa) and several thousand degree (\( \gamma \) eV) temperatures. Densities of condensed matter can now be increased over an order of magnitude, causing novel transformations and new physical and chemical phenomena to occur. Growth in this area has been made possible by advances in diamond-anvil cell methods coupled with a wide range of probes, including x-ray diffraction, spectroscopy, inelastic scattering, radiography, and infrared spectroscopy using synchrotron radiation. Examples include investigations of dense hydrogen; transformations in molecular materials; novel ceramics; new types of superconductors, electronic, and magnetic materials; and liquids and amorphous materials. Particularly exciting are new developments in time resolved methods and coupling of static and dynamic compression techniques made possible by the creation of new large-scale facilities and novel technologies.

This research is supported by DOE-NNSA (CDAC), DOE-BES, NSF, NASA, and the W. M. Keck Foundation.

4:06PM E6.00002 To See the Inside of a Planet in a Drop of Deuterium DIDIER SAUMON, Los Alamos National Laboratory — Despite their proximity, the giant planets of the solar system, Jupiter and Saturn, still present a number of fundamental puzzles. The discovery of nearly 300 planets around other stars in all manners of orbital and physical parameters has further complicated the picture. Giant planets are primarily composed of hydrogen and helium but also contain higher Z elements. The global abundances and the radial variation of the composition of a giant planet represents the end state of its formation process. Observations that pertain to the present-day internal structure of giant planets are the primary thread to the physical mechanisms that where at play when they formed several billion years ago. The interior structure is inferred from observations and is not uniquely determined. The modeled structures of Jupiter and Saturn are quite sensitive to the equation of state (EOS) of hydrogen/helium mixtures in the regime of warm dense matter. Unresolved EOS questions of great importance to planetary science include: Is there a first order metallization transition in hydrogen? What is the EOS of H/He mixtures? Is there a phase separation in H/He mixtures that could provide an additional energy source to slow down the cooling of giant planets, as suggested by observations of Saturn? Can a better EOS provide an explanation for the large radii of several extrasolar giant planets? The last decade has seen a tremendous experimental effort focused on shocked deuterium EOS measurements complemented by a renewed interest in ab initio simulations of H and very recently, He. Those experiments have been crucial in improving EOS models that had been mostly unencumbered by data. New experimental techniques, such as isentropic compression, will reproduce conditions closer to planetary interiors than current data EOS data. When combined with ab initio simulations of H/He mixtures, a much clearer understanding of the interiors of giant planets and of their formation should emerge.

This work was supported by DOE under contract DE-AC52-06NA25396.
understanding the complex time evolution and/or spectral structure in gamma-ray bursts, relativistic jets, and supernova remnants. The deflected electrons has different properties than synchrotron radiation which is calculated in a uniform magnetic field. This jitter radiation may be important to particle (electron, positron, and ion) acceleration. The simulation results show that the Weibel instability is responsible for generating and amplifying highly acceleration is due to plasma waves and their associated instabilities (e.g., the Weibel (filamentation) instability) created in the shocks are responsible for plasma waves and their associated instabilities (e.g., the Weibel (filamentation) instability) created in the shocks are responsible for particle (electron, positron, and ion) injection into a stationary medium show that particle acceleration occurs within the downstream jet. In the collisionless relativistic shock particle acceleration is due to plasma waves and their associated instabilities (e.g., the Weibel (filamentation) instability) created in the shocks are responsible for particle (electron, positron, and ion) injection into a stationary medium show that particle acceleration occurs within the downstream jet. In the collisionless relativistic shock

**Saturday, April 12, 2008 3:30PM - 5:18PM —**

**Session E7 GPAP: Astrophysicists’ Perspectives on Current Problems in Plasma Astrophysics**

**Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Rose Garden**

**3:30PM E7.00001 Plasma Physics in Clusters of Galaxies, JEAN EILEK, New Mexico Tech — Clusters of galaxies are the largest self-gravitating structures in the universe. Each cluster is filled with a large-scale plasma atmosphere, in which the interstellar matter is mixed with the stars that have been processed inside the stars. This magnetized cluster plasma contains both thermal and relativistic species, and is a wonderful laboratory for applying ideas and tools developed in other areas of plasma physics. Although clusters formed many Gyr ago, the cluster plasma is still being energized today — but we are not sure by what. The plasma will clearly be affected by ongoing evolution of the gravitating matter in the cluster. Jets driven out from massive black holes in cluster-member galaxies will also impact the cluster plasma. Understanding the importance of these two drivers is one of today's major questions. Radio and X-ray observations have told us a great deal about the plasma atmosphere in the cluster, but the data alone cannot answer the big questions. We need to understand the physical and dynamic state of the cluster plasma; to get there from the data we must use tools and knowledge from MHD and plasma physics. Questions which need to be answered range from plasma mixing across magnetic surfaces, to acceleration of relativistic particles, to the nature of the MHD turbulence and dynamos in the cluster environment.**

**4:06PM E7.00002 Astrophysical problems for which high-energy-density physics can matter, R. PAUL DRAKE, University of Michigan — The physical scope of astrophysics is vast, spanning all of physics and more. High-energy-density physics (HEDP), concerned with dense and/or high-pressure systems constituting roughly to energy densities above 10^12 ergs/cc, connects with a variety of problems in astrophysics. Astrophysical problems to which HEDP can contribute include either the physical properties or the nondonimensional dynamics now accessible in the laboratory. In assembling a model of planetary structure one must know the relation of pressure and density in the HEDP range; this is being explored in ongoing experiments. Stellar structure the situation is similar with regard to x-ray opacities. Dynamic astrophysical systems are often approximately hydrodynamic, from clump destruction by shock waves to supernova remnant evolution to post-collapse stellar explosions. These systems typically are at high Reynolds number and involve very strong shock waves, which creates the ability to undertake very-well-scaled HEDP experiments aimed at specific problems. Such experiments are now beginning to show results that are not anticipated in computer simulations, and to prove useful in working with astrophysical data. Systems having a dynamically important magnetic field are more difficult. Understanding radiating systems in astrophysics poses substantial challenges, from the atomic physics involved in photoionization to the structure of radiative shocks in several regimes to the challenge of doing accurate simulations involving both radiation and hydrodynamics. Laboratory work in these areas is much less mature, but there is progress in the study of photoionized plasmas and radiative shocks, and in related simulations.**

**4:42PM E7.00003 The interstellar magnetic field: plasma problems, RUSSELL KULRSUD, Princeton Plasma Physics Laboratory — I will discuss a number of unsolved plasma problems whose solution will help in understanding the origin and evolution of the interstellar magnetic field. The prevailing theory of the origin of this field from a weak primordial seed field is the alpha-omega dynamo driven by interstellar turbulence. During the operation of this dynamo it is necessary for some flux to be expelled from the disc, and this has to happen without removing the interstellar medium as well. How this happens is an important astrophysical problem involving plasma physics. Furthermore, the turbulence initially produces small scale fields on scales below the inner scale of the turbulence. When the interstellar magnetic field is extremely weak the bulk plasma is still controlled by the orbits of the particles in the weak field. During this phase there are strong parallel and perpendicular pressure instabilities whose saturation has not been successfully worked out, and whose consequences are not understood. These instabilities can control the initial buildup of the interstellar magnetic field and impact its origin. The role of magnetic reconnect, in these early phases as well as later times when the field is strong, is not understood. Finally, the actual physics of magnetic reconnection itself is not understood. I will discuss the astrophysical importance of all these plasma problems.**

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1This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344

3Work sponsored by the Stewardship Sciences Academic Alliances program, through DOE Research Grant DE-FG52-04NA00064 and by other grants and contracts.

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**Saturday, April 12, 2008 3:30PM - 5:06PM —**

**Session E8 GGR DAP: Gamma Ray Bursts, Gravitational Wave Bursts, Supernovae**

**Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade A**

**3:30PM E8.00001 Relativistic Particle-In-Cell Simulation Studies of Prompt and Early Afterglows from GRBs, KEN-ICHI NISHIKAWA, NSSTC/UAH, PHILIP HARDEE, UA, YOSUKE MIZUNO, NSSTC/MSFC, GERALD FISHMAN, NASA/MSFC — Nonthermal radiation observed from astrophysical systems containing relativistic jets and shocks, e.g., gamma-ray bursts (GRBs), active galactic nuclei (AGNs), and Galactic microquasar systems usually have power-law emission spectra. Recent PIC simulations of relativistic electron-ion (electro- positron) jets injected into a stationary medium show that particle acceleration occurs within the downstream jet. In the collisionless relativistic shock particle acceleration is due to plasma waves and their associated instabilities (e.g., the Weibel (filamentation) instability) created in the shocks are responsible for particle (electron, positron, and ion) acceleration. The simulation results show that the Weibel instability is responsible for generating and amplifying highly nonuniform, small-scale magnetic fields. These magnetic fields contribute to the electron’s transverse deflection behind the jet head. The “jitter” radiation from deflected electrons has different properties than synchrotron radiation which is calculated in a uniform magnetic field. This jitter radiation may be important to understanding the complex time evolution and/or spectral structure in gamma-ray bursts, relativistic jets, and supernova remnants.**
3:42PM E8.00002 A Blind Search for Transient Bursts of Very High Energy γ-rays using Milagro gamma-Rays Using Milagro . VLASIOS VLASILIOU, University of Maryland, College Park, MILAGRO COLLABORATION — Milagro is a water-Cherenkov detector capable of observing air showers produced by γ-rays. The wide field of view (~2 sr) and high duty cycle (>90%) of Milagro make it ideal for searching for transient very high energy emission. We will report on the results of a blind search of the Milagro data for very high energy γ-ray outbursts within the Milagro field of view for durations ranging from 1ms to 6 minutes. While this analysis is primarily aimed at detecting γ-ray bursts (GRBs), it could also be sensitive to other phenomena like primordial black-hole evaporation and soft γ-ray repeaters. No trigger from another instrument is required, instead the entire reconstructed data set is systematically searched in time, space and emission duration. Four years of Milagro data are searched, which corresponds to 2520 sr days of exposure. While the peak sensitivity of Milagro is above 1 TeV, the detector has substantial effective area at lower energies (~50 m² at 100 GeV, ~2500 m² at 1 TeV).

3:54PM E8.00003 Acceleration and survival of ultrahigh-energy cosmic-ray nuclei in gamma-ray bursts and hypernovae . SOEBUR RAZZAQUE, U.S. Naval Research Laboratory, XIANG-YU WANG TEAM, PETER MESZAROS TEAM — Recent results from the Pierre Auger Observatory hint that ultrahigh-energy cosmic-rays above an EeV energy may be composed of heavy nuclei rather than nucleons. This naturally leads to the questions of their origin and acceleration at the astrophysical objects. Gamma-ray bursts and hypernovae have been proposed to be the sources of ultrahigh-energy cosmic-rays. We explore different physical conditions under which heavy nuclei may be accelerated and survive in the environment of these sources, and report our findings.

1Supported by NSF AST 0307376 and NASA NAG5-13286 grants.

4:06PM E8.00004 Searches for gravitational-wave inspirals from short GRBs . NICKOLAS FOTOPOULOS, University of Wisconsin-Milwaukee, LIGO SCIENTIFIC COLLABORATION — Short Gamma Ray Bursts (GRBs) are widely believed to be produced in the merger of a double neutron star binary or a neutron star-black hole binary. Such systems produce strong gravitational waves, which could be detectable by the Laser Interferometer Gravitational-wave Observatory (LIGO). Because the time and the location of such an event is known, LIGO data can be searched in coincidence with a GRB with a lower threshold than previous untriggered searches. We present the results of a search for compact binary inspirals in LIGO data around GRB 070201 and plans for extending this search to other GRBs that occurred during LIGO’s latest science run.

4:18PM E8.00005 Coherent Network Searches for Gravitational Waves Associated with Gamma-Ray Bursts . GARETH JONES, Cardiff University, LIGO SCIENTIFIC COLLABORATION, VIRGO COLLABORATION — Over 200 gamma-ray bursts (GRBs) were observed electromagnetically during the LIGO science run 5 / Virgo science run 1. Attempts to detect gravitational waves (GWs) associated with GRBs can take advantage of the known sky position and time of the GRB to increase the sensitivity of the search. Coherent analysis methods are particularly well-suited to such directional searches. They use the known sky position to construct linear combinations of the data that maximize or minimize the SNR of a GW signal with a given polarization. This allows for both high sensitivity to real GWs and powerful consistency tests for eliminating background noise, without a priori assumptions on the GW waveform. We discuss prospects for GRB-GW searches with data taken during the LIGO science run 5 / Virgo science run 1.

4:30PM E8.00006 Analysis Method to Search for Coincidence Events between the LIGO-Virgo Gravitational-wave Detector Network and the IceCube Neutrino Detector . YOICHI ASO, Columbia University, CHAD FINLEY, University of Wisconsin Madison, ZSUZSA MARKA, JOHN DWYER, Columbia University, KELI KOTAKE, National Astronomical Observatory of Japan, SZABOLCS MARKA, Columbia University — Violent astrophysical phenomena such as gamma-ray bursts may produce gravitational wave emission along with high energy neutrinos. A network of gravitational wave detectors such as LIGO and Virgo can detect the direction of gravitational wave bursts while the IceCube neutrino detector can also provide accurate directional information for neutrino events above 100 GeV. By combining timing and directional information of events from these two independent detectors, we can search for coincident events that may arise from common astrophysical sources. The coincidence analysis reduces the false alarm rate, and this in turn allows the trigger threshold to be relaxed and improves the ability to detect a shared class of sources. While the method can be applied to various combinations of detectors, we will present our method specifically for the case of the LIGO-Virgo network and IceCube, using the results of Monte Carlo simulations to demonstrate its performance.

4:42PM E8.00007 Gravitational waves from core-collapse supernova using CHIMERA . KONSTANTIN YAKUNIN, STEPHEN BRUENN, PEDRO MARRONETTI, Florida Atlantic University, SHIN YOSHIDA, Albert Einstein Institute — We perform numerical simulations of core-collapse supernovae using the multi-dimensional hydrodynamics code CHIMERA that includes realistic nuclear reactions as well as spectral neutrino transport. We present gravitational wave signals from progenitor stars with different rotational profiles, studying the effects of neutrino radiation in the emission of gravitational waves. These GW templates can be used to enhance the search for supernovae signals in current and future GW detectors.

4:54PM E8.00008 Search for transient gravitational waves associated with Soft Gamma Repeaters using the LIGO detectors . PETER KALMUS, Columbia University, LSC COLLABORATION — During part of LIGO’s fifth science run from November 2005 to May 2007, satellite-based gamma-ray detectors observed more than 200 bursts from the Soft Gamma Repeaters SGR 1806-20 and SGR 1900+14. These objects are located within our galaxy and their sky locations are known to high precision. Models predict gravitational wave emission via excitation of non-radial modes in the compact source, making them plausible targets for a gravitational wave search. The majority of the SGR events occurred while multiple LIGO detectors were collecting data with high sensitivity. We present the status of the search for transient gravitational waves associated with SGR events using coherent combination of data from multiple LIGO detectors. Coherent methods can be used to search for any transient gravitational wave signal in the band 100-3000 Hz, including neutron star ringdowns. Upper limits on gravitational wave emission energies can be estimated using simulated white noise burst and ringdown waveforms.

Saturday, April 12, 2008 3:30PM - 4:42PM –
Session E10 GGR: Self Force and Gravitational Wave Tails  Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis A
in the context of the toy model of scalar-field self forces for circular orbits in Schwarzschild. The m-mode approach has several advantages, most notably the amenability to numerical solutions in the time domain, thus benefiting from experience gained by several groups in the numerical solution of linearized wave equations on a Kerr background in the time domain in 2+1D, and the adaptability to more complex orbits, including generic ones. As a first step we implement this program for the simpler context of circular orbits in Schwarzschild. Notably, we do not exploit the spherical symmetry of the Schwarzschild background or the symmetry of the orbit. Instead, we construct the scheme so that generalizations to either more complex orbits or to Kerr spacetime are susceptible of implementation at later stages, and work in 2+1D. This talk is a progress report on work still ongoing.

3:42PM E10.00002 Power-law tails in the Kerr spacetime, Richard Price, University of Texas at Brownsville, Reinaldo Glei-ser, Universidad Nacional de Cordoba, Argentina, Jorge Pullin, Louisiana State University — In the Schwarzschild spacetime, compact initial perturbations evolve to “tails” that decay as \( t^{-3} \). We present new numerical and analytic results that clarify the value of \( n \), and the features of the spacetime on which \( n \) depends.

3:54PM E10.00003 Late-time Kerr tails revisited, Lior M. Burko, University of Alabama in Huntsville, Gaurav Khanna, University of Massachusetts Dartmouth — Numerous conflicting results — both analytical and numerical — have been reported on the decay rate of late time tails in the Kerr spacetime. In particular, there has been much disagreement on whether the decay rate of an initially pure multipole moment \( \ell \) is according to \( t^{-(2\ell+3)} \), where \( \ell \) is the least multipole moment whose excitation is not disallowed, or whether the decay rate is according to \( t^{-n} \), where \( n = 2\ell+3 \) if \( \ell - m < 2 \), \( n = \ell + m + 1 \) if \( \ell - m \geq 2 \), and even, and \( n = \ell + m + 2 \) if \( \ell - m \geq 2 \) is odd. The answer to this question is very sensitive to the details. In particular, it is very important whether one specifies the velocity or the momentum of the field as part of the initial-data set. We do careful 2+1D numerical simulations, and find the tails decay-rate for the case that has become the testbed of such studies, specifically an initially pure \( \ell = 4 \), \( m = 0 \) multipole on a Boyer-Lindquist or ingoing Kerr time slices. We also consider other cases, including non-azimuthal ones, such as an initial \( \ell = 6 \), \( m = 2 \) multipole. We emphasize some of the causes for potential errors in 2+1D simulations and argue that conflicting past results may be attributed to them. Specifically, we discuss the misidentification of an intermediate tail as an asymptotic one and the misidentification of noise evolution as that of a signal. We then show that our simulations are free of such errors.

4:06PM E10.00004 Regularization of fields for self-force problems in curved spacetime: foundations and a time-domain application, Iain Vega, Steven Detweiler, University of Florida — We report on recent tests of a new approach towards the calculation of self-forces and waveforms arising from moving point charges in curved spacetimes. As opposed to mode-sum schemes that regularize the self-force derived from the singular retarded field, this approach regularizes the retarded field itself. The singular part of the retarded field is first analytically identified and removed, yielding a finite, differentiable remainder from which the self-force is easily calculated. This regular remainder satisfies an effective wave equation which enjoys the benefit of having a non-singular source. Our method of field regularization then involves directly solving this effective wave equation for the remainder, which avoids the difficulties associated with numerical models for singular sources, while providing easy access to the self-force on the charge without the need for further regularization or slowly-convergent mode sums. In this talk, we shall discuss our preliminary implementation of this method using a 4-order (1+1) code applied to the simple case of a scalar charge moving in a circular orbit around a Schwarzschild black hole. Comparisons with highly-accurate, frequency-domain results indicate agreement to \( \sim 0.1\% \).
3:54PM E11.00003 Measurement of W Boson Production Charge Asymmetry at CDF, BO-YOUNG HAN, KEVIN MCFARLAND, University of Rochester, EVA HALKIADAKIS, Rutgers University, CDF COLLABORATION — We present a measurement of the W boson production charge asymmetry using the $W \rightarrow e\nu$ decay channel. We use data collected by the Collider Detector at Fermilab from $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV. The data represent an integrated luminosity of 1 fb$^{-1}$. Our measurement of the W production charge asymmetry is compared to higher order QCD predictions generated using MRST2006 and CTEQ6 parton distribution functions. The asymmetry provides new input on the momentum fraction dependence of the u and d quark parton distribution functions within the proton.

4:06PM E11.00004 Identification of Electromagnetic Particles using the Forward Hadron Calorimeter at CMS, KEVIN KLAPOETKE, University of Minnesota, CMS COLLABORATION — The detection and identification of electrons and photons will be important for many analyses at the LHC and the design of the CMS crystal electromagnetic calorimeter has been optimized for this purpose. CMS also has a forward hadronic calorimeter (HF) made up of quartz-fiber and iron. We describe how electromagnetic particles can be reconstructed and identified in the HF. Transverse and longitudinal shower shape variables distinguish between electromagnetic particles and jets. We describe the impact of identifying electromagnetic particles for physics analysis, specifically the measurement of the $Z$ boson.

4:18PM E11.00005 CMS Plans for Inclusive Z Cross-Section Measurement in the Electron Channel, JASON HAUPIT, University of Minnesota, CMS COLLABORATION — Measurement of the basic electroweak parameters will be one of the first priorities at CMS. We discuss the plan to measure the inclusive cross-section for Z production in the dielectron channel. All efficiencies which are to be derived from data are measured from the Z to ee decays via the tag and probe method. We show the results of testing this procedure with a nominal 10$^{-3}$ pb of simulated data and applying the efficiencies to determine the inclusive cross-section.

4:30PM E11.00006 Measurement of Inclusive W Production Cross Section in the Electron Channel, HAIDUONG NGUYEN, Brown University, CMS COLLABORATION — Precision electroweak measurements are one of the first priorities for the LHC physics program with the first data. We discuss measurement of the W production cross section in the electron decay channel using the dta-driven approach to estimate signal efficiency and the background. The expected measurement uncertainties for the data sets corresponding to the integrated luminosities between 100 pb$^{-1}$ and 1 fb$^{-1}$ are discussed.

4:42PM E11.00007 Angular Distributions in unpolarized proton-induced Drell-Yan process, LINGYAN ZHU, Hampton University, JEN-CHIEH PENG, University of Illinois at Urbana-Champaign, PAUL REIMER, Argonne National Laboratory, FERMILAB E866/NUSEA COLLABORATION — We will report a measurement of the angular distributions of Drell-Yan dimuons produced using an 800 GeV/c proton beam on a deuterium target. The muon angular distributions in polar angle $\theta$ and azimuthal angle $\phi$ have been measured over the kinematic range $4.5 < m_{\mu\mu} < 15$ GeV/c$^2$, $0 < p_T < 4$ GeV/c, and $0 < x_F < 0.8$. The data will be compared with the angular distribution in unpolarized pion-induced Drell-Yan, in terms of angular coefficients and the Lam-Tung relation. The expectations from two models will be discussed. One involves QCD vacuum effect and the other involves transverse-momentum-dependent Boer-Mulders structure function $h_2^\perp$. The preliminary results with proton target will be also presented.

5:06PM E11.00008 Measurement of the Mass of the $\tau$ Lepton, PARKER LUND, University of California at Irvine, BABAR COLLABORATION — Using a pseudomass technique, we present the first precision measurement with the BaBar detector of the mass of the $\tau$ lepton using $\tau \rightarrow 3\nu\nu_e$ decays. The measurement will use 446 million $\tau^+\tau^-$ pairs produced in the 485 fb$^{-1}$ of data collected by the BaBar detector at the PEP-II asymmetric-energy $B$ Factory.

5:28PM E11.00009 Measurement of the Charged Kaon Mass Using the MIPP RICH, NICK GRAF, Indiana University, MIPP COLLABORATION — The current charged kaon mass of 493.677 MeV/\(c^2\) $\pm 26$ parts per million (ppm) is dominated by two measurements of kaonic atom $x$-ray energies. These measurements have precisions of 14 and 22 ppm, respectively, and differ by 122 ppm. Given its importance in measurements of $V_{ud}$ from $K^+\nu$ decay, resolution of the ambiguity in charged kaon mass measurements is needed. This talk describes a method for making a measurement with 40 ppm statistical precision from the correlation between $p$, $\pi$, and $K$ RICH radii and precisely known values of proton and pion masses. Analysis of data from the Main Injector Particle Production (MIPP) experiment taken during spring 2006 at Fermilab is presented.

Saturday, April 12, 2008 3:30PM - 5:18PM – Session E12 DPF: B Physics II

3:30PM E12.00001 Search for the Radiative Decays $B \rightarrow \Delta \gamma \gamma$ and $B \rightarrow \Sigma \gamma \gamma$, JAN STRUBE, University of Oregon, BABAR COLLABORATION — We report the results of a search for the radiative baryonic decays $B \rightarrow \Delta \gamma \gamma$ and $B \rightarrow \Sigma \gamma \gamma$ in a sample of 380 million $B$ decays recorded at the $\Upsilon(4S)$ resonance of the PEP-II facility with the BaBar detector. We present branching fractions for these channels and investigate mass and angular distributions of the di-baryon system, which provide insight into the decay mechanism.

3:42PM E12.00002 Technique for an improved measurement of the $\Upsilon(4S) \rightarrow B^0 \bar{B}^0$ branching fraction, ROMULUS GODANG, University of South Alabama, BABAR COLLABORATION — We present a technique for improving the determination of the $\Upsilon(4S) \rightarrow B^0 \bar{B}^0$ branching fraction using data collected by the BaBar detector at the PEP-II asymmetric-energy $e^+e^-$ collider at SLAC. We present the projected precision of the improved measurement and what can be learned from such a measurement.

3:54PM E12.00003 Measurement of the Branching Fraction of $\bar{B}^0 \rightarrow D^{*+}\ell^--\bar{\nu}$ by Partial Reconstruction, ROMULUS GODANG, University of South Alabama, BABAR COLLABORATION — We present the branching fraction measurement of $\bar{B}^0 \rightarrow D^{*+}\ell^--\bar{\nu}$ using data collected with the BaBar detector at the PEP-II $e^+e^-$ storage rings at the Stanford Linear Accelerator. We conduct the measurement by partially reconstructing the $D^{*+}$ mesons from $\bar{B}^0 \rightarrow D^{*+}\ell^--\bar{\nu}$ decays. We will discuss the methodology and provide preliminary estimates of the branching fraction of $\bar{B}^0 \rightarrow D^{*+}\ell^--\bar{\nu}$ using the partial reconstruction technique.

4:06PM E12.00004 $B$ meson decays to $K_1(1270)\pi$ and $K_1(1400)\pi$, ALESSANDRO BERRA, INFN Sezione di Milano, BABAR COLLABORATION — We present preliminary results of branching fraction measurements of $B^0$ meson decays to $K_1(1270)^{+}\pi^-$ and $K_1(1400)^{+}\pi^-$. The data sample corresponds to 384 million $B\bar{B}$ pairs collected with the BaBar detector at the PEP II asymmetric energy $e^+e^-$ collider.
4:18PM E12.00005 Measurement of the Lifetime of the $B_c^\pm$ Meson Using Semileptonic Decays
, MARK HARTZ, University of Pittsburgh, CDF COLLABORATION — We report on a measurement of the lifetime of the $B_c^\pm$ meson using the semileptonic decay modes $B_c^\pm \rightarrow J/\psi \ell^\pm X$ with $J/\psi \rightarrow \mu^+\mu^-$. The measurement utilizes 1 fb$^{-1}$ of data collected with the CDF II detector during Run II of the Fermilab Tevatron in $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV. The measurement combines the $J/\psi\mu^\pm$ and $J/\psi\bar{\mu}^\pm$ final states in a single framework to increase the statistical reach of the data while minimizing systematic differences between the two final states.

4:30PM E12.00006 Angular Time-dependent Analyses of the Decays $B_d \rightarrow J/\psi K^{0*}$ and $B_s \rightarrow J/\psi \phi$ at D0
, G. ALEJANDRO GARCIA-GUERRA, CINVESTAV-Mexico, D0 COLLABORATION — We report preliminary results on the $B_d$ and $B_s$ angular time-dependent analyses in the exclusive decay channel $B_d \rightarrow J/\psi(\mu^+\mu^-)K^{0*}(\rightarrow K^-\pi^+\pi^-)$. We use approximately 2.8 fb$^{-1}$ of data collected at the D0 detector during 2003-2007. From our measurements we are able to measure the angular and the lifetime parameters ($|A_0|^2$, $|A_1|^2$, $\delta_1$, $\delta_2$ and $\tau_d$) that describe this decay in the transversity basis. We performed the same analysis for the untagged decay $B_s \rightarrow J/\psi(\mu^+\mu^-)\phi(\rightarrow K^+K^-)$ assuming no CP violation, and measured the parameters ($|A_0|^2$, $|A_1|^2$, $\delta_1$, $\delta_2$, $\Delta t_A$ and $\tau_s$). Finally, we report the lifetime ratio $\tau_s/\tau_d = 1.035 \pm 0.060$ (stat) $\pm 0.004$ (syst). We compare our measurements with the theoretical predictions for the factorization method and the SU(3) symmetry for these decays.

4:42PM E12.00007 CP Violation in $B \rightarrow DK$ Decay Modes at CDF
, PAOLA GAROSI, INFN Pisa, CDF COLLABORATION — The CKM angle $\gamma$ can be cleanly determined from CP asymmetries in suppressed $B^+ \rightarrow D^0K^+$ decays, where it enters at tree-level. These measurements do not require flavor tagging and are currently statistics-limited, which makes them particularly interesting for hadron colliders. We present the latest CDF results for the submodes $D^0 \rightarrow K^+K^-$, $\pi^+\pi^-$ (CP+ modes) and the DCS mode $D^+ \rightarrow K^{*+}\pi^-$.

5:06PM E12.00009 Rare B Decays at D0
, ANDREAS WENGER, University of Zurich, D0 COLLABORATION — Studies of the B meson system are motivated both by precise consistency tests of the standard model (SM) and for searching for indirect effects of new physics. In the SM flavour changing neutral currents (FCNC) are absent at tree level but appear in higher order diagrams through box and penguin diagrams. B meson decays involving such FCNC have branching ratios of order $10^{-7}$ to $10^{-6}$ in the SM, but are expected to be enhanced in many models beyond the SM. Investigations into some rare decays like $B \rightarrow \pi\mu\mu$ will be presented, using data taken by the D0 experiment at Fermilab.

Saturday, April 12, 2008 3:30PM - 5:18PM — Session E13 DNP: Minisymposium on Nuclear Physics Deep Underground III
Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis F

3:30PM E13.00001 A Large Underground Xenon (LUX) WIMP dark matter experiment
, STEVEN DAZELEY, Lawrence Livermore National Laboratory, LUX COLLABORATION — The LUX collaboration has proposed to build a few hundred kilogram dual phase Xenon WIMP dark matter detector at the 4890 foot level of the new SUSEL site in South Dakota. The design builds on the apparent scalability of the recent Xenon10 and Zeplin II experiments, which employed a similar technique. LUX will have an order of magnitude larger volume and introduce a new way to reduce the backgrounds from WIMP like nuclear recoil events, placing the whole detector inside an active water shield/neutron detector. I will briefly describe the design of the detector/shield concept, and summarize the implications for our sensitivity to WIMP dark matter.  

3:42PM E13.00002 The LUX Apparatus
, LOUIS KASTENS, Yale University, LUX COLLABORATION — The LUX experiment will search for Weakly Interacting Massive Particles (WIMPs) using a liquid Xenon time projection chamber. Simultaneous measurement of ionization and scintillation allows for 3D position reconstruction, with a nuclear recoil energy threshold as low as 4.5keV. The ratio of ionization and scintillation allows event discrimination between nuclear and electronic recoils, and self-shielding provides additional gamma ray background reduction. A water shield will protect the detector from gamma rays and neutrons from the surrounding rock. With 300 kg of LXe, LUX is expected to improve sensitivity to WIMPs by a factor of 100. LUX plans to deploy to the Sanford Laboratory at the Homestake mine in late 2008 to begin taking data. I describe the construction and strategy behind the LUX detector.

3:54PM E13.00003 Background simulations of the XENON100 dark matter detector
, GUILLAUME PLANTE, Columbia University, XENON COLLABORATION — The XENON100 detector is a dual-phase xenon time projection chamber (XeTPC) used to search for dark matter in the form of weakly interacting massive particles (WIMPs) by measuring simultaneously the scintillation and ionization signals produced by nuclear recoils. The 65 kg XeTPC is instrumented by 178 PMTs and is surrounded by a 85 kg LXe active veto with 64 PMTs. All materials and components used to build the detector (PMTs, PMT bases, stainless steel, PTFE, copper, etc) have been screened with high purity germanium detectors operating at the Gran Sasso underground laboratory. Special attention has been paid to the choice of construction materials. Using the measured radioactivity as input to the Monte Carlo, we have simulated the response of the XENON100 detector to obtain the expected gamma and neutron backgrounds, which largely determine the sensitivity reach of the experiment.

We acknowledge continued support by the National Science Foundation.

3Supported by internal Laboratory Directed Research and Development funds at LLNL.
4:06PM E13.00004 Scintillation Efficiency of Liquid Xenon for Low Energy Nuclear Recoils, TARITREE WONGJIRAD, KAIXUAN NI, ANGEL MANZUR, LOUIS KASTENS, DANIEL MCKINSEY, Yale University — In early 2006, the XENON and ZEPLIN collaborations announced highly stringent upper limits on the WIMP-nucleon cross-section. However, the dominant systematic uncertainty in these limits is due to the uncertainty in the nuclear recoil scintillation efficiency (NRSE) for liquid xenon. The NRSE is defined as the amount of scintillation produced by nuclear recoils, divided by the amount of scintillation produced by electron recoils, per unit energy. Though the NRSE has been measured by several groups, its value at the low energies most important for the liquid xenon WIMP searches has a large uncertainty. Furthermore, the NRSE may vary with the strength of the electric field in the liquid xenon. In an attempt to reduce these uncertainties, we have measured the NRSE down to 5 keV nuclear recoil energy for various electric fields.

4:18PM E13.00005 The Mini-CLEAN dark matter experiment, DAN MCKINSEY, Yale University, DEAP/CLEAN COLLABORATION — The design and current status of the Mini-CLEAN experiment are presented. Mini-CLEAN is an experiment designed to search for nuclear recoils produced by elastic scattering of dark matter particles in a 360 kg noble liquid target. The apparatus may be operated with either liquid argon or liquid neon as the detection material, providing different responses to signal and background. Ionizing radiation events in the noble liquid produce intense scintillation light, which is captured in a spherical array of photomultipliers immersed in the cryogen. Reduction of beta and gamma backgrounds is accomplished through pulse-shape discrimination, which has been shown to be highly effective in both liquid argon and liquid neon. Mini-CLEAN will be installed in SNOLAB in late 2008.

4:30PM E13.00006 Depletion of $^{39}$Ar for Direct Dark Matter Detection Experiments, ZHONGBAO YIN, The University of South Dakota, ANDREW HIME, Los Alamos National Laboratory, DONGMING MEI, The University of South Dakota — Liquid argon, which has shown excellent background discrimination capabilities, is very suitable for construction of tonne-scale target mass detectors at reasonable cost for the WIMP searches. We have investigated via simulations the pulse shape discrimination (PSD) power and found that it depends strongly on the deposited energy and the detected number of photoelectrons per unit energy. To discriminate the backgrounds from $^{39}$Ar decays for a tonne-scale dark matter detector, it requires a PSD capability better than $10^{10}$, which can only be achievable at a higher threshold energy. Furthermore, without $^{39}$Ar depletion, data acquisition dead-time would be unlikely manageable for a tonne-scale detector and a large scale computing facility would be required to perform on-line data reduction. While with depletion of $^{39}$Ar by a large factor we can not only reduce the background rate, but also make it possible to lower the detection threshold so as to access larger parameter space of WIMPs predicted by minimal super-symmetric models. In this talk, we will further outline the several $^{39}$Ar depletion technologies under investigation in our institutions.

4:42PM E13.00007 Discovery of underground argon with low level of radioactive $^{39}$Ar and possible applications to WIMP dark matter detectors, CRISTIANO GALBIATI, Princeton University — We report on the first measurement of $^{39}$Ar in argon from underground natural gas reservoirs. The gas stored in the US National Helium Reserve was found to contain a low level of $^{39}$Ar. The ratio of $^{39}$Ar to stable argon was found to be $<4\times10^{-17}$ (84% C.L.), less than 5% the value in atmospheric argon ($^{39}$Ar/Ar=8x10$^{-16}$). The total quantity of argon currently stored in the National Helium Reserve is estimated at 1000 tons. $^{39}$Ar represents one of the most important backgrounds in argon detectors for WIMP dark matter searches. The findings reported demonstrate the possibility of constructing large multi-ton argon detectors with low radioactivity suitable for WIMP dark matter searches.

4:54PM E13.00008 Depleted Argon from Old-Water Underground at Wall, South Dakota, JASON SPAANS, DONGMING MEI, University of South Dakota, ANDREW HIME, Los Alamos National Laboratory, ZHONGBAO YIN, MILES KOPPANG, YONGCHEN SUN, University of South Dakota, VICTOR GEHMAN, Los Alamos National Laboratory, DEAP/CLEAN COLLABORATION — The purpose of this project is to investigate the possibility of using underground water as a source for depleted argon which will be the target material for next generation dark matter detectors at deep underground laboratories and to design a machine that would extract argon from underground water. The only source of $^{39}$Ar from old underground water is $^{39}$Ar that is produced from (n,p) reactions with $^{39}$K. An analysis of the soil was conducted to determine the $^{39}$K content and the number of free neutrons due to $(\alpha, n)$ reactions induced by $^{233}$Th and $^{238}$U decay. This was done with atomic absorption spectrometry and a low background counting facility, respectively. The results indicated that the soil contains approximately 2% $^{39}$K and 2 neutrons/y/g/ppm. As a result, $^{39}$Ar is predicted to be about a factor of 70 lower than atmospheric level. In addition, a machine was designed that would be capable of extracting argon from underground water.

5:06PM E13.00009 Progress Towards A 60 kg Bubble Chamber for Dark Matter Detection, ANDREW SONNENSCHEIN, Fermilab, COUPP COLLABORATION — The COUPP collaboration has been investigating the use of bubble chambers for direct detection of dark matter. Our progress in developing a stable 2 kg CF3I bubble chamber with long superheated life time has led us to start construction on a significantly larger detector with a sensitive mass of 60 kg. I will give an overview of the challenges in engineering this detector and discuss the status of its construction.

Saturday, April 12, 2008 3:30PM - 5:06PM – Session E14 DNP: Theory Involving Finite Nuclei

3:30PM E14.00001 Spectroscopy of $^7$He hypernucleus in three-body model, BRANISLAV VLADOVIC, VLADIMIR SUSLOV, IGOR FILIKHIN, North Carolina Central University, Durham NC — The $^7$He hypernucleus is considered as three-body cluster system $^3$He+$^4$N+$^3$N [1]. Configuration space Faddeev calculations are performed for the hyperon binding energy. In particular we obtained the binding energy 5.35 MeV, which agrees with preliminary theoretical predictions (5.4 MeV) [2]. Note that this value differs from the recent experimental data [3]. Discussed is the recipe for extracting hyperon binding energy from the three-body calculations. The value obtained in previous E. Hiyama’s et al[4] calculation has to be corrected. A variant of the method of analytical continuation in coupling constant is applied to calculate the energies of resonance levels of the $^7$He. The second bound state of $^7$He with total angular momentum $J = 3/2^+$ ($5/2^+$) was found. The bound states and low-lying resonances of $^7$He can be classified as an analog of the $^6$He ground band. 1. I. Filikhin, V. M. Suslov and B. Vlahovic, J. Phys. G31 389 2005. 2. O. Hashimoto, HYP2006 Mainz, October 11-14, 2006. 3. L. Tang,

$^3$This work was partially supported by the Department of Defense through the Grant W911NF-05-1-0502.


3:42PM E14.00002 Full configuration interaction calculations of light nuclei1. PIETER MARIS, JAMES VARY, ANDREY SHIROKOV2, Department of Physics and Astronomy, Iowa State University, Ames, IA 50011 — We perform full configuration interaction (FCI) calculations for light nuclei with a realistic NN interaction, JISP16. We obtain ground state energies and their uncertainties through an exponential extrapolation that we demonstrate is reliable in testcases up to A=4 where fully converged results are obtained. For heavier nuclei, up through Carbon-12, we obtain ground state energies converged to a few percent. In addition to the energies, we also calculate several observables such as rms radii and quadrupole moments.

1Supported in part by USDOE grants DE-FC02-07ER41457 and DE-FG-02-87ER40371
2Home institution: Skobeltsyn Institute of Nuclear Physics, Moscow State University, Moscow, 119991 Russia

3:54PM E14.00003 Nuclear shell structure in anharmonic oscillator potential, F. BARY MALIK, Southern Illinois University Carbondale, ANUP MAJUMDER, Allergan Inc. & University of Phoenix Online — The studies of binding energies of light and medium-light nuclei have established anomalous trend of shell structure compared to the one expected in the case of isotropic harmonic oscillator for nuclei away from the valley of stability and close to the drip lines. We have, therefore, studied the nature of the shell-gap expected in anharmonic three dimensional oscillator potential with a spin-orbit and 1.1 term. The energy gaps among minor shells are strongly dependent on the degree of anisotropy and the strength of the spin-orbit coupling. Many of the anomalous gaps e.g. large gap for N = 14 and dwindling gap for N = 8 could be ascribed to anisotropic harmonic mean field. Thus, many of the exotic nuclei seem to have large deformation and need to be treated with anisotropic harmonic basis set or described by rotational model with rotational-particle coupling. Typical level scheme as a function of anharmonicity will be presented.


1Supported by the U.S. DOE Grant DE-FG02-88ER40414, NNSF (China) Grant No. 10405007(YW)

4:18PM E14.00005 Effective Shell-Model interactions for the p-shell from the No-Core Shell Model1, A.F. LISETSKIY, M.K.G. KRUSE, B.R. BARRETT, University of Arizona, P. NAVRATIL, LLNL, I. STETCU, LANL, J. VARY, Iowa State U. — The ab initio no-core shell model (NCSM) is a powerful many-body technique to perform fundamental microscopic studies of the structure of light nuclei. However, it becomes rather challenging to produce converged results for nuclei with $A \geq 12$. In this contribution, following the idea of Ref. [2] we derive effective p-shell Hamiltonians from $N_{\text{max}}=\hbar \Omega$ NCSM calculations for $^{6}$Li with $N_{\text{max}}=2,4,\ldots,14$. We show how the averaged many-body correlations modify the p-shell two-body Hamiltonian and explore the dependence of the effective one-body and two-body matrix elements on $N_{\text{max}}$. We present the results of the standard shell model calculations using derived effective Hamiltonian for p-shell nuclei with $A > 6$ and compare it to the exact NCSM results.

2Supported in part by NSF grant PHY-0555396, DOE grant No. DE-AC52-06NA25396, USDOE grant DE-FG-02-87ER40371 and prepared by LLNL under contract No. DE-AC52-07NA27344.

4:30PM E14.00006 Effective Shell-Model interactions for $^{18}$F from the No-Core Shell Model1, M.K.G. KRUSE, A.F. LISETSKIY, B.R. BARRETT, University of Arizona, P. NAVRATIL, LLNL, I. STETCU, LANL, J.P. VARY, Iowa State U. — Insight gained from projected No Core Shell Model calculations in the p-shell can now be utilized to obtain information about and to construct effective Shell Model two-body matrix elements (TBMEs) for heavier nuclei. Here we report on a NCSM investigation of $^{18}$F model space for $^{18}$F in order to determine effective TBMEs for the sd-shell. These matrix elements accurately account for the many-body correlations present in the original large space and can be compared to the empirical (or theoretical) TBMEs employed in a traditional core shell-model calculation. Results for other effective operators, specifically electromagnetic, will also be presented.

1Supported in part by NSF grant PHY-0555396, DOE grant No. DE-AC52-06NA25396, USDOE grant DE-FG-02-87ER40371 and prepared by LLNL under contract No. DE-AC52-07NA27344.

4:42PM E14.00007 Projected Configuration Interaction Method for Heavy Nuclei1, MIHAI HOROI, ZAOCHUN GAO, Department of Physics, Central Michigan University, Mount Pleasant, MI 48859 — The nuclear Configuration Interaction (CI) method using a spherical single particle (s.p.) basis has been very successful in describing the properties of the low-lying states of the light and medium size nuclei. The main shortcoming of this method is related to the exploding dimensions that could make the calculations unfeasible even when one changes the number of nucleons and/or s.p. states by one unit. In addition, the relation of the correlated spherical wave functions to the mean field picture is either indirect or very difficult to make. The Projected Configuration Interaction (PCI) method starts from a collection of mean-field wave functions, and builds up correlated wave functions of good symmetry. It relies on the Generator Coordinator Method (GCM) techniques, but it improves the past approaches by a very efficient method of selecting the basis states. We compare the results of this method with the results of the full CI calculations in the sd and fp shell, as well as with the standard GCM, the Quantum Monte Carlo Diagonalization (QMCD) method (e.g. Phys. Rev. C 59, R1846 (1999)), and the complex MONSTER/VAMPIR method (e.g. Nucl. Phys A 571, 77 (1994)).

1Supported by the National Science Foundation and the US Department of Energy.
initially titled Nuclear Information, what was then known about the biological effects of radiation. Some of our members testified at Congressional committee hearings. We published a newsletter, of nuclear energy.” In accordance with its objectives, members of C.N.I. gave many nontechnical talks, where we described the various forms of radiation and understand the present and future problems which arise from potential large-scale use of nuclear weapons in war; testing of nuclear weapons; and nonmilitary uses

E. U. Condon and Barry Commoner. The aim of C.N.I. was “to collect and distribute in the widest possible manner information which the public requires to from this fallout. In March 1958, the Greater St. Louis Citizens’ Committee for Nuclear Information (C.N.I.) was formed. Among the leaders of C.N.I. were

University in St. Louis — After W.W.II., the U.S. continued its program for the development of nuclear weapons. Winds carried radioactive debris far beyond

perspective on the physics community of the 1920’s, physics education, and the nuclear panic that followed WWII.

As an educator, she taught an introduction to photography course

various elements using x-ray spectroscopy at the University of Michigan. In her thesis, she showed the potential for x-rays to reduce highly oxidized compounds

Katherine reached a level prominence in the scientific community that few women had achieved. As a scientist, Katherine studied the outer energy levels of

The Inspiring Life of Katherine Chamberlain

— Some Recollections Of Life At Los Alamos Before And After Trinity

Some Recollections Of Life At Los Alamos Before And After Trinity

— Did the Allies Know in 1942 About Nazi Germany’s Poor Prospects for an Atomic Bomb?

— Revisiting the 100 Year Old Radioactivity Lectures of Frederick Soddy

— Did the Allies Know in 1942 About Nazi Germany’s Poor Prospects for an Atomic Bomb?

— Remembering Los Alamos, E. LEONARD JOSSEМ, Department of Physics The Ohio State University

— Arthur Compton’s 1941 Analysis of Explosive Fission in U-235: The Physics

— The Manhattan Project and its Effects on American Women Scientists

— X-Ray Spectroscopy, The Ellen Richards Prize, and Nuclear Proliferation: The Inspiring Life of Katherine Chamberlain

— From Alamogordo to the Nuclear Test-Ban Treaty

4:54PM E14.00008 Checker Board Model, THEODORE LACH — The Checker Board Model (CBM) is a 2D model of the nucleus that proposes that the synchronization of two outer rotating quarks in the nucleons accounts for magnetic moment of the nucleons and that the resulting magnetic flux couples (weaves) into the 2D checker board array structures and this 2D magnetic coupling in addition to electrostatic forces of the two rotating and one stationary quark accounts for the apparent strong nuclear force. The symmetry of the He nucleus helps explain why this 2D structure is stable. This model explain the mass of the proton and neutron, along with their magnetic moments and their absolute and relative sizes and predict the masses of two newly proposed quarks (1), the “up” and the “dn” quarks. Since the masses of the “up” and “dn” quark determined by the CBM (237.31 MeV and 42.392 MeV respectively) did not fall within the standard model as candidates for u and d, a new model (New Physics) had to be invented. The details of this new nuclear


Saturday, April 12, 2008 3:30PM - 5:18PM –

Session E15 FHP: Manhattan Project and Beyond

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis H

3:30PM E15.00001 Remembering Los Alamos, E. LEONARD JOSSEМ, Department of Physics The Ohio State University

3:54PM E15.00002 Did the Allies Know in 1942 About Nazi Germany’s Poor Prospects for an Atomic Bomb?, HARRY LUSTIG, The City College of the C.U.N.Y, emeritus — According to official accounts, the U.S. knew nothing about Nazi Germany’s efforts to get an atomic bomb until the end of the World War II, but had feared the worst. As it turned out, the Germans had made little progress. But did someone in the Allied camp know in 1942? In his 1986 book, The Griffin, Arnold Kramisch relates how Paul Rosbaud, a spy for MI6, the British secret intelligence service, kept his handlers informed during the War about the German atomic project and reported the decision to give up on a bomb. Kramisch’s revelations are, understandably, thinly documented and Rosbaud’s name can hardly be found independently anywhere else. But as Samuel Goudsmit’s papers in the Bohr Library show, he knew and communicated with Rosbaud from August 1945 on. In 1986, 15 letters exchanged by Goudsmit and Rosbaud were removed by the Government from the Library and eventually placed in the National Archives under classification review. Renewed interest in the Rosbaud story was engendered last year when his family sued MI6 in an English court for the release of the Rosbaud file. So far the spy agency has refused to reveal even that there is such a file. Discovering authoritatively what Rosbaud told the British and what they did with the information is clearly of historical interest.

4:18PM E15.00003 Revisiting the 100 Year Old Radioactivity Lectures of Frederick Soddy, CHRISTINE HAMPTON — Between 1908 and 1922, Frederick Soddy, MA., FRS (Dr. Lee’s Professor of Inorganic and Physical Chemistry, Univ. of Oxford) published four editions of a compendium of his experimental lectures delivered at the University of Glasgow, under the title “The Interpretation of Radium, and the Structure of the Atom”. Professor Soddy taught his students about ‘radium writing’ and the emanation of radium. He presented a radium clock designed by Professor Strutt; showed students ‘Pleochroic Halos’; and described the separation of ‘ionium’ from its isotope, thorium. The process of constructing a cohesive logic to empirical observations of this newly discovered phenomenon of radioactivity was a challenging one. Some aspects did not stand the test of time. However, revisiting these lectures after 100 years gives us fascinating insight into the mental processes of the early pioneers in radioactivity.

4:30PM E15.00004 Arthur Compton’s 1941 Analysis of Explosive Fission in U-235: The Physics, CAMERON REED, Alma College — In November 1941 Arthur Compton prepared a report for Vannevar Bush regarding the possibility of explosive fission of U-235. This remarkable report, arguably the parent document of the Los Alamos Primer, presented detailed estimates for the critical mass, expected energy release, efficiency, destructive effects and probable cost of such a weapon. This paper will examine the physics behind Compton’s estimates for the critical mass and efficiency of a fission weapon and compare his results to those derived from present-day cross-sections and secondary-neutron numbers. His approach to the efficiency calculation is found to be particularly interesting in that it utilizes some very basic undergraduate physics.

4:42PM E15.00005 The Manhattan Project and its Effects on American Women Scientists, SAMUEL FLETCHER, Princeton University — There have been many detailed historical accounts of the Manhattan Project, but few have recognized the technical role that women scientists and engineers crucially played in the Project’s success. Despite their absence from these prominent accounts, recent studies have revealed that, in fact, women participated in every non-combat operation associated with the Manhattan Project. With such extensive participation of women and such a former lack of historical attention upon them, little analysis has been done on how the Manhattan Project might have influenced the prospects of women scientists after the war. This talk has two aims: 1) to recount some of the technical and scientific contributions of women to the Manhattan Project, and 2) to examine what effects these contributions had on the women’s careers as scientists. In other words, I intend offer a preliminary explanation of the extent to which the Manhattan Project acted both as a boon and as a detriment to American women scientists. And finally, I will address what this historical analysis could imply about the effects of current efforts to recruit women into science.

4:54PM E15.00006 X-Ray Spectroscopy, The Ellen Richards Prize, and Nuclear Proliferation: The Inspiring Life of Katherine Chamberlain, MATTHEW GERAMITA, University of Michigan — In 1924, Katherine Chamberlain became the first woman to receive a doctorate in physics from the University of Michigan. As one of the first women in the world to earn a doctorate in physics, Katherine reached a level prominence in the scientific community that few women had achieved. As a scientist, Katherine studied the outer energy levels of various elements using x-ray spectroscopy at the University of Michigan. In her thesis, she showed the potential for x-rays to reduce highly oxidized compounds and in 1925 won the Ellen Richards Prize for the world’s best scientific paper by a woman. As an educator, she taught an introduction to photography course for thirty-five years in the hopes of creating new ways to inspire a love for physics in her students. As a community leader, she worked with The United World Federalists and The Michigan Memorial Phoenix Project to find peaceful uses for nuclear energy. Looking at these aspects of Chamberlain’s life offers a unique perspective on the physics community of the 1920’s, physics education, and the nuclear panic that followed WWII.

5:06PM E15.00007 From Alamogordo to the Nuclear Test-Ban Treaty, MICHAEL FRIEDLANDER, Washington University in St. Louis — After W.W.II., the U.S. continued its program for the development of nuclear weapons. Winds carried radioactive debris far beyond the Nevada test site, and these fission products were deposited by rain, to enter the human food chain. The isotopes of greatest concern were Sr90 and I131, that, after ingestion, become concentrated in bone and thyroid respectively. There was a growing public anxiety about possible heath hazards posed by radiation from this fallout. In March 1958, the Greater St. Louis Citizens’ Committee for Nuclear Information (C.N.I.) was formed. Among the leaders of C.N.I. were E. U. Condon and Barry Commoner. The aim of C.N.I. was “to collect and distribute in the widest possible manner information which the public requires to understand the present and future problems which arise from potential large-scale use of nuclear weapons in war; testing of nuclear weapons; and nonmilitary uses of nuclear energy.” According in accordance with its objectives, members of C.N.I. gave many nontechnical talks, where we described the various forms of radiation and what was then known about the biological effects of radiation. Some of our members testified at Congressional committee hearings. We published a newsletter, initially titled Nuclear Information, and later Scientist and Citizen. In this presentation, I will describe some of the activities of this idealistic organization.
4:05PM -
Session 8HE HEDP HEDLA: HEDP/HEDLA Poster Session (4:05-6:30pm) Hyatt Regency St. Louis
Riverfront (formerly Adam039;s Mark Hotel), Promenade E and Promenade Lobby

8HE.00001 From dimensional analysis to Burgan-Feix transformation: a self-similar and unified analysis , EMERIC FALIZE, SERGE BOUQUET, CEA-LUTH — Self-Similar Solutions (SSS) play a key role in physics and astrophysics. They give basic information about physical systems and are an essential complement to numerical simulations. Several approaches, based on properties of invariance, exist and provide many classes of solutions compatible with only specific initial conditions (IC). In order to make sure that solutions be compatible with any boundary and/or IC, Burgan and Feix derived a transformation group - which we name the Burgan-Feix Transformation (BFT) - based upon the concept of partial invariance. The BFT leads also to new solutions through more complex analytical calculations. Including IC in the structure of solutions is very appropriate for High-Energy-Density experiments. In this work, we will propose a progressive approach, from dimensional analysis to BFT, providing SSS containing increasing degree of complexity. Moreover, we will present the theory of the BFT with different point of view.

8HE.00002 Self-similar evolution, structure and stability of optically thin plasmas: analytical and numerical study , EMERIC FALIZE, CEA-LUTH, BERENICE LOUPIAS, LULI, SERGE BOUQUET, CEA-LUTH, CLAIRE MICHAUT, LUTH, MICHEL KOENIG, LULI — In this work we will consider, analytically and numerically, the multi-dimensional dynamics (expansion and collapse) of optically thin plasmas. We will present self-similar solutions when the cooling function can be written in power law forms. These solutions are obtained using the Burgan-Feix transformation which consists in a generalized self-similar transformation. We will establish the plasma configurations compatible with cooling flows. It turns out that from a multi-dimensional analysis these solutions apply to jets as well as supernovae remnant dynamics. We compare these results with numerical simulations. Moreover, virial theorem predicts the existence of instability that we will physically identify. Thus, we will present the study of the linear stability of the radial and non-radial evolution and the study of the non-linear regime with numerical simulations. We will discuss the astrophysical implications of these results and their reproduction in laboratory.

8HE.00003 Investigation of flute and lower hybrid drift instabilities in application to laboratory astrophysics and Z-pinch experiments1 , V.I. SOTNIKOV, V. IVANOV, R. PRESURA, J. KINDEL, University of Nevada at Reno, NV 89523 USA, J.N. LEBEOUF, JNL Scientific, Casa Grande, AZ 85222, USA, O.G. ONISHCHENKO, Institute of Physics of Earth, 123995 Moscow, Russia, B.V. OLIVER, T.A. MEHLHORN, Sandia National Laboratories, NM 87123 USA, C. DEENEY, Department of Energy, Washington, DC 20585 USA — In a cylindrical Z-pinch plasma column and in a laser ablated plasma flows interacting with an external magnetic field conditions are favorable for excitation of flute and lower hybrid drift oscillations. Linear analysis of the flute mode instability in a finite beta Z-pinch plasma has demonstrated good agreement between theory and experimental data. Laboratory experiments on the interaction of a plasma flow, produced by laser ablation of a solid target with the inhomogeneous magnetic field demonstrated the presence of strong wave activity in the region of the flow deceleration. Excitation of flute-type modes as well as LHD waves with plasma and magnetic field parameters, corresponding to the ongoing experiments is examined.

1Work supported by the US Department of Energy under Grant No. DE-FC52-01NV14050 at UNR, and Contract DE-AC04-94AL65000 at Sandia National Laboratories

8HE.00004 Progress toward Kelvin-Helmholtz instabilities in a High-Energy-Density Plasma on the Nike laser1 , E.C. HARDING, R.P. DRAKE, R.S. GILLESPIE, M.J. GROSSKOPF, C.M. HUNTINGTON, University of Michigan, Y. AGLITSKIY, J.L. WEAVER, A.L. VELIKOVICH, Naval Research Laboratory, T. PLEWA, Florida State University, V.V. DWARKADAS, U. of Chicago — In the realm of high-energy-density (HED) plasmas, there exist three primary hydrodynamic instabilities of concern: Rayleigh-Taylor (RT), Richtmyer-Meshkov (RM), and Kelvin-Helmholtz (KH). Although the RT and the RM instabilities have been readily observed and diagnosed in the laboratory, the KH instability remains relatively unexplored in HED plasmas. Unlike the RT and RM instabilities, the KH instability is driven by a lifting force generated by a strong velocity gradient in a stratified fluid. Understanding the KH instability mechanism in HED plasmas will provide essential insight into oblique shock systems, jets, mass stripping, and detailed RT-spike development. In addition, our KH experiment will help provide the groundwork for future transition to turbulence experiments. We present 2D FLASH simulations and experimental data from our initial attempts to create a pure KH system using the Nike laser at the Naval Research Laboratory.

1Work supported by the Naval Research Lab through NRL-N00173-06-1-C906, DoE, and Livermore National Lab

8HE.00005 Structure of solutions of the buoyancy – drag equation , SERGE BOUQUET, EMERIC FALIZE, CEA-LUTH, PIERRE GANDEBOU, PIERRE PAILHORIES, CEA — In this paper, the well-known buoyancy-drag equation (BDE) is studied. This equation describes the non linear regime of Rayleigh – Taylor instabilities and also the structure of the mixing zone where both fluids are present. Analytical solutions of the BDE are derived for time-dependent accelerations, γ(t), of the form γ(t) ∼ t^n where the exponent n can be positive, negative or zero. It is shown, first, that the width, h(t), of the mixing zone behaves like h(t) ∼ t^(n+2) and, second, provided the initial conditions satisfy some constraints, the special solution h(t) is an attractor for t going to infinity. On the other hand, the behavior of the asymptotic solutions for γ(t) ∼ t^n is examined in terms of the drag coefficient, C_d, that is present in the drag force (proportional to the square of the derivative dh/dt) in the right hand side of the BDE. Critical values for this coefficient are derived analytically and it is shown that the asymptotic behaviors are strongly dependent on the value of C_d. These results are also evidenced from numerical simulations achieved with the CLAWPACK numerical package.

8HE.00006 Using the Rayleigh-Taylor instability for in situ measurements of thermal conductivity of warm dense matter , DMITRI RYUTOV, Lawrence Livermore National Laboratory, Livermore, CA 94551 — The Rayleigh-Taylor instability of the material with stratified density, temperature, and composition is considered. The variation of composition gives rise to the appearance of modes whose growth rate is directly related to the finite thermal conductivity (D.D. Ryutov, Phys. Plasmas, v.7 , p. 4797, 2000). It is proposed to use this effect for in situ measurements of thermal conductivity of warm dense matter. Expressions for the growth rate for the general equation of state are derived and the modes that are most convenient for the aforementioned measurements are identified. A desired perturbation can be introduced by machining the package or by using masks during the surface deposition process. To visualize the evolution of the embedded perturbation, higher-Z tracers can be used. A concept of a laser-driven experiment where this approach can be realized is presented. Prepared by LLNL under contract DE-AC52-07NA27344.
8HE.00007 Simulation and Analysis of Mixing Layer Evolution in Multi-Mode, Laser-Driven Rayleigh-Taylor Experiments

NATHAN HEARN, ASC Flash Center, University of Chicago, Chicago, Illinois, TOMASZ PLEWA, School of Computational Science, Florida State University, Tallahassee, Florida, R. PAUL DRAKE, Space Physics Research Laboratory, University of Michigan, Ann Arbor, Michigan, CAROLYN KURANZ — Recent experiments at the Omega laser facility have produced data of sufficient quality to investigate structural details of single- and multi-mode Rayleigh instability growth. The FLASH hydrodynamics code has been used to model these experiments in two and three dimensions. We present a comparison between the experimental data and raytraced images of the three-dimensional simulations, and we also explore the effects of choosing different adiabatic indexes for our ideal-gas realizations of the two fluids. Finally, we contrast the simulated evolution of single- and double-mode perturbations in terms of their mixing layer growth and mass distributions. In accordance with theoretical expectations, we find that short-wavelength modes show the fastest initial growth, and that the structure of the mixing layer is eventually dominated by the longer modes.

1 We acknowledge support from DOE Contract B523820.

8HE.00008 Using Hydrodynamic Codes in Modeling of Multi-Interface Diverging Experiments for NIF

MICHAEL GROSSKOPF, University of Michigan, R.P. DRAKE, C.C. KURANZ, University of Michigan, T. PLEWA, Florida State University, N. HEARN, C. MEAKIN, University of Chicago, D. ARNETT, University of Arizona, A.R. MILES, H.F. ROBEY, J.F. HANSEN, B.A. REMINGTON, W. HSING, M.J. EDWARDS, Lawrence Livermore National Laboratory — Using the Omega Laser, researchers studying supernova dynamics have observed the growth of Rayleigh-Taylor instabilities in a high energy density system. The NIF laser hopes to generate the energy needed to expand these experiments to a diverging system. We report scaling simulations to model the interface dynamics of a multilayered, diverging Rayleigh-Taylor experiment for NIF using CALE, a hybrid adaptive Lagrangian-Eulerian code developed at LLNL. Specifically, we looked both qualitatively and quantitatively at the Rayleigh-Taylor growth and multi-interface interactions in mass-scaled systems using different materials. The simulations will assist in the target design process and help choose diagnostics to maximize the information we receive in a particular shot. Simulations are critical for experimental planning, especially for experiments on large-scale facilities.

This research was sponsored by LLNL through contract LLNL B56128 and by the NNSA through DOE Research Grant DE-FG52-04NA00064.

8HE.00009 Richtmyer-Meshkov instability in elastic-plastic media

ANTONIO R. PIRIZ, JUAN J. LÓPEZ CÉLA, Universidad de Castilla - La Mancha, NAEEM A. TAHIR, GSI Darmstadt, DIETER H. H. HOFFMANN, Technical University of Darmstadt — Hydrodynamic instabilities are of great importance in the LAPLAS (Laboratory of Planetary Sciences) experiment that is being designed for the study of high energy density states of matter in the framework of the FAIR project. During the implosion of the LAPLAS cylindrical target Richtmyer-Meshkov (RM) instability occurs when a shock is launched into a material with elastic and plastic properties that determines the physics of the instability evolution. We have studied the evolution of the interface from which the RM instability is launched as a consequence of the RM instability. For this we have developed an analytical model and we have performed two-dimensional numerical simulations in order to validate the model. Model and simulations show the asymptotic stability state in which the interface oscillates elastically around a mean value higher than the initial perturbation amplitude. Such a mean value is determined by an initial plastic phase. Applications to the measurement of yield strengths of materials under extreme conditions are foreseen.

8HE.00010 Theoretical and numerical studies of Vishniac instability in supernova remnants

CÉCILE CAVET, HUNG CHINH NGUYEN, CLAIRE MICHAUT, LUTH, Observatoire de Paris, CNRS, EMERIC FALIZE, SERGE BOUQUET, CEA/DIF, DPTA — In this work, the Vishniac instability is first of all theoretically studied in supernova remnants. This instability is sometimes invoked to explain fragmentation of interstellar medium, but its role is not correctly demonstrated. Conditions and assumptions required for the instability growth are detailed and explained. In addition, an experimental feasibility of the Vishniac instability combined with a radiative shock experiment is examined with the high-power laser facility, i.e., LIL (Bordeaux, France). Another part of this study is also to simulate this instability, because we would compare its numerical growth rate with analytical theory which we derived as an extension of the initial approach by Vishniac. To lead this numerical work we have developed an hydrodynamic code (called HYDRO-MUSCL) and we will show new results.

8HE.00011 3D RAGE Simulations of Sapphire Balls Driven by Strong Shocks

B.H. WILDE, R.F. COKER, LANL, P.A. ROSEN, J.M. FOSTER, AWE, P.M. HARTIGAN, R. CARVER, Rice U, A. FRANK, U of Rochester, J.F. HANSEN, LLNL, B.E. BLUE, GA — The goal of our 2007-2008 NLUF experiments at the Omega laser facility is to investigate the physics associated with the interaction of strong shocks and jets with clumpy media. These experiments have close analogs with structures observed in a variety of astrophysical flows, including jets from young stars, outflows from planetary nebulae, and extragalactic jets. In these experiments, a multi-mega bar shock is created in a plastic layer by heating a hohlraum to 190 eV temperature with 5 kJ of laser energy. The shock enters a 0.3 g/cc RF foam into which are embedded 500 micron diameter sapphire balls. The shock shears off the ball such that it creates thin two-dimensional sheets of sapphire which subsequently break up and undergo the three-dimensional Widnall instability. The time evolution of the ball/balls is diagnosed with dual-axes point-projection radiography. In this poster, we discuss the results of high-resolution three-dimensional radiation-hydrodynamic simulations with the adaptive-mesh-refinement RAGE code of single and multiple balls. Comparisons with data from our shots will be made.

8HE.00012 Fluid Solvers For High-Energy Density Applications: Initial Results

AMMAR HAKIM, JOHN LOVERICH, Tech-X Corporation — We have developed a general purpose, parallel, high-performance framework, TxFluids, for the solution of plasma fluid equations. TxFluids works on both structured (hexahedral) and unstructured (mixed tetrahedral and hexahedral) meshes and uses modern high-order and high-resolution schemes to solve the MHD equations formulated as systems of hyperbolic conservation laws. In particular, we have implemented the High-Resolution Wave Propagation Scheme and the Discontinuous Galerkin (DG) Scheme. Both these schemes are particularly suited to plasma physics problems as they are very accurate, fully upwind and also capture shocks. In the absence of shocks the DG scheme in TxFluids is spectrally accurate, i.e. it can be run with arbitrary spatial order specifiable in the input file. This allows us to resolve complex flow features even with coarse meshes and is hence valuable to study turbulence and micro-instabilities. TxFluids allows coupled simulations using different fluid models. Among these, we have presently implemented the resistive-MHD model, the Hall-MHD model and the full two-fluid model. The latter includes electron physics needed to simulate micro-instabilities like the Lower-Hybrid Drift Instability. As an application we present initial results of simulating a Magneto-Inertial Fusion (MIF) concept. Here an aluminum liner is collapsed on a target plasma (a Field-Reversed Configuration) to produce intense magnetic fields and fusion conditions. We present results of the FRC formation, translation and heating due to adiabatic compression.
8HE.00013 Laboratory investigation of bow shocks in radiatively cooled plasmas, D.J. AMPLEFORD, C.A. JENNINGS, Sandia National Laboratories, S.V. LEBEDEV, G.N. HALL, S.N. BLAND, S.C. BOTT, F. SUZUKI-VIDAL, J.B.A. PALMER, J.P. CHITTENDEN, Imperial College London, A. CIARDI, Observatoire de Paris — Magnetized and radiatively cooled shocks are present in many astrophysical systems. The early stage of a wire array z-pinch implosion consists of the steady ablation of material from fine metallic wires. Ablated material is accelerated toward the array axis by the JxB force. This flow is highly supersonic (M ≈ 5) and becomes super-Afvenic (MA > 2). Radiative cooling is significant in this flow, and can be controlled by varying the material in the ablated plasma. The introduction of a wire as an obstruction in this steady flow leads to the formation of bow shocks.

8HE.00014 A Jet Production Experiment using the ASTRA Laser, JONATHAN WAUGH, University of York, ERIK BRAMBREK, CHRIS GREGORY, MICHEL KOENIG, LULI, Ecole Polytechnique, YASUHIRO KURAMITSU, Institute of Laser Engineering, Osaka, BERENICE LOUPIAS, LULI, Ecole Polytechnique, YOUICHI SAKAWA, Institute of Laser Engineering, Osaka, LUCY WILSON, NIGEL WOOLSEY, University of York — Plasma jets were produced by the ablation of material with an intense short pulse laser from conical and groove shaped impressions in targets. The use of a high repetition rate laser allowed the use of a variety of jet materials, background gases and gas pressures. Plasma jets coming from plastic, Al, Cu and Au targets were observed and propulsion of these stagnating plasmas into background He, N2 and Xe gases was studied. Interferometry data is used to infer the time dependent density of the stagnating region and the launch and propagation of shocks into the background gas. Here, the first analysed results from this experiment are presented.

8HE.00015 Directed Plasma Flow across Magnetic Field, P. PRESURA, Y. STEPANIENKO, S. NEFF, V.I. SOTNIKOV, Nevada Terawatt Facility, University of Nevada, Reno — The Hall effect plays a significant role in the penetration of plasma flows across magnetic field. For example, its effect may become dominant in the solar wind penetration into the magnetosphere, in the magnetic field advection in wire array z-pinch precursors, or in the arcing of magnetically insulated transmission lines. An experiment performed at the Nevada Terawatt Facility explored the penetration of plasma with large Hall parameter (~10) across ambient magnetic field. The plasma was produced by ablation with the short pulse high intensity laser Leopard (0.35 ps, 10^17 W/cm^2) and the magnetic field with the pulsed power generator Zebra (50 T). The expanding plasma assumed a jet configuration and propagated beyond a distance consistent with a diamagnetic bubble model. Without magnetic field, the plasma expansion was close to hemispherical. The ability to produce the plasma and the magnetic field with distinct generators allows a controlled, quasi-continuous variation of the Hall parameter and other plasma parameters making the experiments useful for benchmarking numerical simulations.

8HE.00016 Laser-triggered millimeter-scale collimated plasma jets in crossed electric and magnetic fields, P. BRADY, H. QUEVEDO, P. VALANJU, M. MCCORMICK, R. BENGTSON, T. DITMIRE, University of Texas at Austin — We present a laser plasma triggered jet experiment where we produce millimeter-scale collimated outflows from a cylindrically symmetric electrode configuration motivated by astrophysical jets. The electrode design consists of a grounded plane with a ~1 cm diameter hole and a wire aligned normally to this plane, with its tip placed at the center of the hole. A rapid discharge is formed between the wire and ground plane when a laser pulse hits an aluminum target placed above the electrodes, creating plasma which closes the circuit. The resulting current and corresponding magnetic fields give rise to a plasma jet. The jets were 0.1–0.3 cm wide, about 2 cm in length, had velocities ~40 km/s and an estimated plasma density of less than 10^17 cm^-3. To study the effects of magnetic fields on jet evolution, we have embedded the plasma in axially directed permanent magnetic fields with strength up to 0.4 Tesla. We measured the evolution of the jet over duration of ~1 μs with nanosecond resolution using a fast ICCD camera and interferometer. Under certain conditions the jets also form helical structures due to kink instabilities and the onset is characterized. We compare the dynamics of the plasma jet with one dimensional MHD codes.

8HE.00017 Dense Plasma Injectors for the HyperV Plasma Jets, F DOUGLAS WITHERSPOON, RICHARD BOMGARDNER, ANDREW CASE, SARAH MESSER, SAMUEL BROCKINGTON, HyperV Technologies Corp. — HyperV is developing high velocity dense plasma jets for application to fusion and HEDP. The approach uses symmetric pulsed injection of high density plasma into a coaxial EM accelerator having a cross-section tailored to prevent formation of the blow-by instability. Work to date has focused on injection using ablative plasma sources, such as capillaries and sparkgaps, but injection of pure plasma, such as D and T, or high-Z gases such as Argon, require a different approach. We describe experiments and diagnostic measurements to develop small parallel plate raiguns (MiniRailguns) to generate high density plasma pulses for injection into the coax gun. We also present a brief update of latest results from the 112 electrode sparkgap gun and the 64 capillary TwoPi plasma jet merging experiment, both of which have been upgraded with higher energy pulse forming networks to double the mass of ablatively injected plasma.

8HE.00018 ABSTRACT WITHDRAWN

8HE.00019 Formation of Magnetically Driven Radiatively Cooled Plasma Jets in the Laboratory, F. SUZUKI-VIDAL, S.V. LEBEDEV, S.N. BLAND, J.P. CHITTENDEN, G. HALL, A. HARVEY-THOMPSON, A. MAROCCHINO, C. NING, Imperial College, A. CIARDI, C. STEHLE, Observatoire de Paris, A. FRANK, E.G. BLACKMAN, University of Rochester, S.C. BOTT, University of California, San Diego, T. RAY, Dublin Institute for Advanced Studies — Previous experiments have successfully shown the formation of magnetically driven radiatively cooled plasma jets which are relevant to the launching of astrophysical jets. The jets in these experiments are driven by the pressure of the toroidal magnetic field produced by the MAGPIE generator which leads to the formation of a magnetic “bubble” surrounding a collimated plasma jet on axis. A modification of this experimental configuration, in which radial wire array is replaced by radial metallic foil, results in the formation of episodic magnetic tower outflows which emerge periodically on timescales of ~30ns. The subsequent magnetic bubbles propagate with velocities reaching ~300km/s and interacting with previous eruptions leading to the formation of shocks. This research was supported by the European Community’s Marie Curie JETSET network (contract MRTN-CT-2004 005952) and the SSAA program of the NNSA (DOE Cooperative Agreement DE-FC03-02NA00057).
8HE.00020 Laboratory experiments to study supersonic astrophysical flows interacting with clumpy environments. PAULA ROSEN, J.M. FOSTER, R.J.R. WILLIAMS, AWE Aldermaston, B.H. WILDE, R. COKER, LANL, P. HARTIGAN, R. CARVER, J. PALMER, Rice University, B.E. BLUE, General Atomics, F. HANSEN, C. SORE, LLNL, A. FRANK, University of Rochester — A wide variety of objects in the universe drive supersonic outflows through the interstellar medium which is often highly clumpy. These inhomogeneities affect the morphology of the shocks that are generated. The hydrodynamics is difficult to model as the problem is inherently 3D and the shocks are subject to a variety of fluid instabilities as they are accelerated and destroyed by the shock. Over the last two years, we have been carrying out experiments on the Omega laser to address the interaction of a dense-plasma jet with a localized density perturbation. More recently, we have turned our attention to the interaction of a shock wave with a spherical particle. We use a 1.6-mm diameter, 1.2-mm length hohlraum to drive a composite plastic ablator (which includes bromine to prevent M-band radiation from preheating the experiment). The ablator acts as a “piston” driving a shock into 0.3 g/cc foam containing a 0.5-mm diameter sapphire sphere. We radiograph along two orthogonal lines of sight, using nickel or zinc pinhole-apertured x-ray backlighters, to study the subsequent hydrodynamics. We present initial experimental results and multi-dimensional simulations of the experiment.

8HE.00021 Astrophysical jet experiments with colliding laser-produced plasmas. CHRIS GREGORY, LULI, Ecole Polytechnique, France, JON HOWE, University of York, UK, BERENICE LOUPIAS, LULI, Ecole Polytechnique, France, SIMON MYERS, University of York, UK, MARGARET NOTLEY, Central laser facility, UK, YOUCHEI KODAMA, Graduate School of Engineering, Osaka, Japan, AKIRA OYA, RYOSUKE KONISHI, Institute of Laser Engineering, Osaka, Japan, MICHEL KEOGNIC, LULI, Ecole Polytechnique, France, NIGEL WOOLSEY, University of York, UK — We present the results of experiments in which jets are created through the collision of two laser-produced plasmas. These experiments use a simple ‘v-foil’ target design: two thin foils are placed at an angle of 140 degrees to each other, and irradiated with a high-energy laser. The plasmas from the rear face of these foils collide and drive plasma jets moving with a velocity of ~300 km/s. By choosing the foil thickness and material to suit the laser conditions available, it has proven possible to create plasma jets for which the relevant scaling parameters show significant overlap with those of outflows associated with young stellar objects (YSOs). Preliminary results are also shown from experiments to study the effect of an ambient gas on jet propagation. Nominally identical experiments are conducted either in vacuum or in an ambient medium of 5 mbar of nitrogen gas. The gas is seen to increase the jet collimation, and to introduce shock structures at the head of the outflow.

8HE.00022 Simulations of the supersonic radiative jet propagation in plasmas. XAVIER RIBEYRE, PHILIPPE NICOLAI, STEPHANE GALERA, VLADIMIR TIKHONCHUK, CELIA — The supersonic plasma jets are ubiquitous in astrophysics. We focus our attention on the jets emanated Herbig-Haro objects. They have velocities of a few hundred km/s and extending for a parsec. The interaction of the jets with the surrounding matter produces two structures at the jet head: the bow shock and the Mach disk. The radiative cooling of these shocks affects strongly the jet dynamics. A tool to understand the physics of these jets is the laboratory experiment. The supersonic jet-plasma interaction with surrounding plasma was studied on the PALS laser facility [1]. A collimated high-Z plasma jet with a velocity exceeding 400 km/s was generated and propagated over a few millimeters length. The jet radiative cooling is an important mechanism of jet formation, and propagation similarly to what was shown in the astrophysical context [2]. We study the jet propagation in plasma and structures of the interaction zone using 2D ALE radiative code CHIC. A comparison between the adiabatic and radiative jets for various relative density ratios is performed. The bow shock and Mach disk evolution and their dependence are studied. A multigroup treatment of the radiative transport makes important differences in the shock structure, compared to the model [2] of radiative losses. [1] Nicolai, Ph., 2006 et al. Phys. of Plasmas 13, 062701 [2] Blondin, J. M. et al., 1990 Astr. Phys. J. 360, 370

8HE.00023 Curved Herbig-Haro Jets: Simulations and Experiments. ANDREA CIARDI, Observatoire de Paris, DAVID J. AMPLEFORD, Sandia National Laboratories, SERGEY V. LEBEDEV, Imperial College, CHANTAL STEHELE, Observatoire de Paris — Herbig-Haro jets often show some degree of curvature along their path, in many cases produced by the ram pressure of a side-wind. We present simulations of both laboratory and astrophysical curved jets and experimental results from laboratory experiments. We discuss the properties and similarities of the laboratory and astrophysical flow, which show the formation of internal shocks and working surfaces. In particular the results illustrate how the break-up of the bow-shock and clumps in the flow are produced without invoking jet variability; we also discuss how jet rotation reduces the growth of the Rayleigh-Taylor instability in curved jets.

8HE.00024 Kelvin-Helmholtz instability in radiative jets: analytical and numerical study. EMERIC FALIZE, CEA-LUTH, FREDERIC DIAS, ENS Cachan, SERGE BOUQUET, CEA-LUTH, NICOLAS CHARPENTIER, CEA — We study the influence of cooling on the Kelvin-Helmholtz instability in the context of astrophysical and laboratory jets. It is clear that YSO jets spread into interstellar medium and consequently they may develop shear instability. We know that YSO jets are radiative (radiative energy losses) and therefore the cooling can play an important role in the morphologic and dynamic evolution of jets [Blondin et al., ApJ 360 370-386 (1990)]. Thus we study the feedback of the radiative process in the Kelvin-Helmholtz instability. The jet rotation introduces a new instability in the linear stability and obtain the different stability branches numerically. These results will permit to validate numerical codes in order to study non-linear regimes.

8HE.00025 Simulations of high energy density plasma physics and laboratory astrophysics experiments. J.P. CHITTENDEN, A. MAROCCHINO, S.V. LEBEDEV, R.A. SMITH, Imperial College, A. CIARDI, Observatoire de Paris, C.A. JENNINGS, Sandia National Laboratory — We show how 3D resistive MHD simulations can be used in the design and interpretation of Laboratory Astrophysics and High Energy Density Plasma Physics experiments at Imperial College, Sandia National Laboratory and Centre d’Etudes de Gramat. Using pulsed power generators to drive conical wire arrays, provides a mechanism of generating radiatively cooled hypersonic jets which model the interaction of jets from young stellar objects with the ISM and the deflection of these jets by side-winds. Radiial wire arrays can be used to study magnetically launched jets, the effects of field topology on jet stability and episodic jets. Radiial arrays also represent a high intensity compact radiation source, with potential applications to inertial confinement fusion. The collision of a magnetically accelerated foil with a gaseous target can be used to study of shock waves with strong radiative cooling. The interaction of a short pulse laser with cluster media can generate expanding blast waves in high energy density plasmas. Simulations of experiments with two cylindrical expanding blast waves, show the evolution of a complex 3D Mach stem, which can be compared to tomographic experimental data.

8HE.00026 Analytical structure of stationary radiative shocks in polars. EMERIC FALIZE, SERGE BOUQUET, CEA-LUTH, CLAIRE MICHAUD, CECILE CAVET, LUTH, MICHEL KÖENIG, ALESSANDRA RAVASIO, LULI — Radiating shocks are very common in polar objects (YSOs). Preliminary results are also shown from experiments to study the effect of an ambient gas on jet propagation. Nominally identical experiments are conducted either in vacuum or in an ambient medium of 5 mbar of nitrogen gas. The gas is seen to increase the jet collimation, and to introduce shock structures at the head of the outflow.

8HE.00027 ABSTRACT WITHDRAWN —
8HE.00028 Design of Jet-Driven, Radiative-Blast-Wave Experiments for Omega EP1, R. PAUL DRAKE, University of Michigan, J.P. KNAUER, Laboratory for Laser Energetics, University of Rochester — We discuss the design of jet-driven, radiative-blast-wave experiments for the Omega EP (EP) laser facility. In experiments motivated by astrophysics, plasma jets have been produced by a number of research teams on a variety of laser and z-pinch facilities. Among those that have driven a bow shock into an ambient medium, none have yet been fast enough to create strong radiative effects in the ambient medium. This becomes possible on EP because of the large amount of energy available (7.5 kJ in 1 ns or 19.5 kJ in 10 ns) when three EP beams are used to drive the experiment. We describe the design and simulations of such experiments for EP. The basic approach is to shock the jet material and then accelerate it through a collimating hole and into a Xe ambient medium. We identify issues that must be addressed through experimentation or further simulations in order to field successful experiments.1

1This research was sponsored by the NNSA through DOE Research Grants DE-FG52-07NA28058, DE-FG52-04NA00064, and other grants and contracts.

8HE.00029 Radiation effects and radiation back reaction in strong and QED-strong pulsed laser fields1, IGOR SOKOLOV, Space Physics Research Lab., U. of M, Ann Arbor, MI 48109, STEFAN BULANOV, FOCUS Center, U. of M, Ann Arbor, MI 48109, NATALIA NAUMOVA, LOA, UMR 7639 ENSTA, Ecole Polytechnique, CNRS, 91761 Palaiseau, France, JOHN NEES, VICTOR YANOVSKY, FOCUS Center, U. of M, Ann Arbor, MI 48109 — A particle counter-propagating in strong laser field may experience QED strong field, as long as the energy associated with its motion is sufficiently high. An electric field may be considered to be QED-strong if it exceeds the Schwinger limit: $E > m_e c^2/\hbar$. Counter-propagating electrons can be generated in the course of strong laser pulse interaction with a solid target, so that QED effects become both macroscopic and significant, at high laser intensities. A correlated example exists in close proximity to a pulsar, where a QED-strong electric field may be exerted by relativistic charged particles, gyrating in the strong magnetic field of a neutron star, as the result of the Lorentz transformation of the electromagnetic field. We offer a model which is based on a numerical procedure to solve the Lorentz-Abraham-Dirac equation, with the self-force, in a classical limit, with QED corrections derived from the solution of the Dirac equation, for QED-strong fields. The QED effects are included into a kinetic physical and PIC numerical model via the effective interaction integral, quantitatively accounting for the electron and positron interactions with virtual photons.

1This work was performed under the auspices of the Los Alamos National Laboratory for the U.S. Department of Energy.

8HE.00030 Applications of Radiation-Driven Blast Waves at Z1, T.E. TIERNEY, R.G. WATT, G.C. IDZOREK, C.L. FRYER, D.L. PETERSON, R.R. PETERSON, H.E. TIERNEY, Los Alamos National Laboratory — Radiation-driven blast waves (BWs) occur when the wave speed of an initially diffusive, supersonic radiation wave becomes subsonic and forms a radiographically-visible, hydrodynamic shock wave. BWs have been shown to be extremely energy sensitive, a fact we exploit as a calorimetry diagnostic. Experiments that use Sandia’s Z-dynamic hohlraum as a quasi-Planckian radiation source often require accurate source energy measurements. We have used BWs as a principal diagnostic in experiments of hohlraum energy loss through diagnostic and entrance holes. We also intend to use BWs as a code validation technique for simulating the interaction between radiation-driven BWs sourced by a supernova with a companion star. We discuss experimental designs that use BWs as a diagnostic, and describe the computational and experimental uncertainties associated with BWs. This work was performed under the auspices of the Los Alamos National Laboratory for the U.S. Department of Energy.

1This work was performed under the auspices of the Los Alamos National Laboratory for the U.S. Department of Energy

8HE.00031 Investigation of the evolution of modulated radiative blast waves created by high intensity laser - cluster interaction, H.J. QUEVEDO, I.T. KIM, W. BANG, D.R. SYMES, J. OSTERHOFF, R. FAUSTLIN, M. MAUER, A.C. BERNSTEIN, TCHILS - The University of Texas at Austin, A.S. MOORE, E.T. GUMBRELL, AWE plc, A.D. EDENS, Sandia National Laboratories, R.A. SMITH, T. DITMIRE, TCHILS - The University of Texas at Austin — Radiative blast waves exhibiting instabilities are common and play an important role in astrophysics. Certain aspects of these astrophysical waves can be reproduced in suitably designed laboratory experiments. Previous laboratory experiments have shown that blast waves can be created from intense laser-cluster interactions and the evolution of these waves in high Z cluster gases is radiative, with trajectories that deviate from an adiabatic Sedov-Taylor expansion. With this approach, we have been studying the evolution of hydrodynamic perturbations on cylindrical blast waves in the radiative regime. In our experiment, cylindrical blast waves are generated by high intensity irradiation of an argon cluster jet. The blast waves’ spatial profile is modified by initially destroying clusters in specific locations using another laser pulse. This modulation then becomes the seed to study the variation in the perturbations’ amplitude. We observe some initial evidence for the oscillatory behavior predicted by the Vishniac model of perturbations on thin shell blast waves.

8HE.00032 Laser driven shocks in a large magnetized plasma1, CHRISTOPH NIEMANN, CARMEN CONSTANTIN, ANDREW COLLETTE, PATRICK PRIBYL, SHREEKRISHNA TRIPATHI, ERIK EVerson, ALEXANDRE GIULOTTI, STEPHEN VINCENA, NATHAN KUGLAND, WALTER GEKELMAN, UCLA, RADU PRESURA, STEPHAN NEFF, CHRISTOPHER PLECHATY, UMR — We will present experiments on the interaction of an energetic laser-produced plasma with a large magnetoplasma. Laser intensities in excess of $10^{12}$ W/cm$^2$ produce an ablating plasma plume with expansion velocities of several 100 km/s. Prior to the laser pulse an ambient plasma with a length of 18 m and a diameter of 50 cm is created at $2x10^{12}$ cm$^{-3}$ and 5 eV in an axial magnetic field of 600 G (the Large Plasma Device). We observe large amplitude Alfven waves radiated from the laser-produced plasma.

1Work supported by the DOE and the Basic Plasma Science Faculty

8HE.00033 Simulations of Radiative Shock Experiments for Omega, F.W. DOSS, R.P. DRAKE, University of Michigan, A. REIGHARD, H.F. ROBEY, L. SUTER, Lawrence Livermore National Laboratory — Astrophysical systems in which radiation transport across a shock front contributes substantially to the properties and dynamics of the system may be modeled in laboratory experiments under high-energy-density conditions. Recent experiments on the Omega laser facility have launched drive disks of Be into shock tubes of Xe gas and then accelerated it through a collimating hole and into a Xe ambient medium. We describe the design and simulations of such experiments for Omega. The basic approach is to shock the jet material and then accelerate it through a collimating hole and into a Xe ambient medium. We identify issues that must be addressed through experimentation or further simulations in order to field successful experiments. We present the results of numerical simulations of such experiments for Omega. The results are presented in the form of several easy-to-use diagrams. Prepared by LLNL under contract DE-AC52-07NA27344.

8HE.00034 ABSTRACT WITHDRAWN –

8HE.00035 Interplay of electrostatic and electromagnetic instabilities for ultra-intense charged particle beams in a plasma, DMITRI RYUTOV, Lawrence Livermore National Laboratory — The physics of ultra-Intense charged particle beams propagating through the plasma is of a significant interest for laboratory astrophysics. Most attention has been directed towards the analysis of electromagnetic filamentation instabilities. On the other hand, there exists a broad class of very powerful electrostatic instabilities, e.g., the Buneman instability. The author considers in a unified fashion linear theory for both types of instabilities under conditions where there is no magnetic field in an unperturbed state (i.e., the beam current is fully neutralized by the plasma current). The following factors are taken into account: the beam energy and angular spread; plasma non-uniformity; particle collisions in the background plasma. The areas of the parameter domain where one or another instability is prevalent are identified; the results are presented in the form of several easy-to-use diagrams. Prepared by LLNL under contract DE-AC52-07NA27344.
8HE.00036 Relativistic Boltzmann equations for the pair plasma in presence of baryon loading, ALEXEY AKSENOV, REMO RUFINI, GREGORY VERESHCHAGIN, ICRANet and University of Rome “Sapienza”. — In the recent publication we analyzed the role of the direct and the inverse binary and triple interactions in reaching thermal equilibrium in homogeneous isotropic pair plasma, starting from a nonequilibrium state. In the present work we extend the analysis to the case of baryon-loaded plasma. The corresponding timescales for thermalization of electrons, positrons, protons and photons are determined out from the numerical solution of the relativistic Boltzmann equations. We include all exact QED collisional integrals for binary reactions, while for the corresponding radiative variants we reduce reaction rates to the known expressions of kinetic coefficients in the thermal equilibrium.

8HE.00037 Pair production in non-uniform electric fields, HAGEN KLEINERT, REMO RUFINI, SHE-SHENG XUE, ICRANet and University of Rome “Sapienza”. — Treating the production of electron and positron pairs in vacuum by a strong electric field as a quantum tunneling process, we derive in semiclassical approximation the pair production rate for nonuniform fields E(z) pointing the z-direction. In addition, we discuss tunneling processes in which an empty atomic bound state is spontaneously filled with a negative-energy electron creating a positron. The general expression is applied to a confined field, a semi-confined field, and a linearly increasing field. The boundary effects of the confined fields on pair-production rates are explicitly evaluated. Finally, we calculate the rate at which the atomic level of a bare nucleus of finite size and large Z are filled by electrons from the vacuum under positrons emission.

8HE.00038 Electron-positron pairs production in an electric potential of massive cores, SHE-SHENG XUE, REMO RUFINI, ICRANet and University of Rome “Sapienza”. — Negative energy states of electrons bounded by a massive core with the charge-mass-radio Q/M and macroscopic radius R, are discussed. We show that the negative energies of bound states are lower than the negative electron mass-energy (-mc^2), and energy-level-crossing occurs. If these bound states are not occupied, electron-positron pair production takes place by quantum tunneling. Electrons fill into these bound states and positrons go to infinity. We explicitly calculate the rate of such pair-production, and compare it with the rates of electron-positron pair-production by the Sauter-Euler-Heisenberg-Schwinger and Hawking processes.

8HE.00039 Radiation of electrons in Weibel-generated fields. — A general case, MIKHAIL MEDVEDEV, University of Kansas. — Weibel instability turns out to be the a ubiquitous phenomenon in High-Energy Density environments, ranging from astrophysical sources, e.g., gamma-ray bursts, to laboratory experiments involving laser-produced plasmas. Relativistic particles (electrons) radiate in the Weibel-produced magnetic fields in the Jitter regime. Conventionally, in this regime, the particle deflections are considered to be smaller than the relativistic beaming angle of 1/\gamma being the Lorentz factor of an emitting particle) and the particle distribution is assumed to be isotropic. This is a relatively idealized situation as far as lab experiments are concerned. We relax both assumptions (i.e., the smallness of the deflection angle and the isotropy of radiating particles) and present the extension of the jitter theory amenable for comparisons with experimental data.

8HE.00040 Effects of Shock Instability on Spin and Kick of Proto-Neutron Star in Supernova Cores, WAKANA IWAKAMI, NAOFUMI OHNISHI, Dept. of Aerospace engineering, Tohoku Univ., KEI KOTAKE, Division of Theoretical Astronomy, National Astronomical Observatory Japan, SHOICHI YAMADA, Science and Engineering, Waseda Univ., KEISUKE SAWADA, Dept. of Aerospace engineering, Tohoku Univ. — We have numerically studied the standing/spherical accretion shock instability (SASI) for a core-collapse supernova. The core-collapse supernova is an explosion of a massive star in the final stage of its evolution. Although this spectacular phenomenon is a key issue for astrophysics, the explosion mechanism has not been understood perfectly. Recently, SASI has widely been noticed since it may play an important role for the explosion mechanism of a core-collapse supernova. In addition to it, the latest studies suggest that SASI may also affect on rotation and kick of a pulsar which is regarded as a neutron star formed by the supernova explosion. The origin of a pulsar spin and kick has been vigorously investigated, but it is still controversial among astrophysicists. We report on the effects of SASI on spin and kick of the proto-neutron star with the results of three-dimensional simulations.

8HE.00041 Roles of shock instability interacting with neutrino radiation on supernova explosions, NAOFUMI OHNISHI, Center for Research Strategy and Support, Tohoku University, WAKANA IWAKAMI, KENICHI SUGAI, Department of Aerospace Engineering, Tohoku University, KEI KOTAKE, Division of Theoretical Astronomy, National Astronomical Observatory Japan, SHOICHI YAMADA, Science and Engineering, Waseda University. — Standing accretion shock instability (SASI) is expected to be a feasible candidate to trigger a core-collapse supernova explosion which has not well understood yet. We have studied this phenomenon with including neutrino heating and realistic EOS and found that SASI may enhance neutrino heating. However, the successful explosion still seems to be difficult without additional excitation process of the shock instability which may be sustained by acoustic-vortex cycle in the supernova cores. We have performed the simulations with g-mode of proto-neutron star that may enhance the SASI growth. Moreover, a new numerical method of neutrino transport for more sophisticated simulations is presented. We discuss also a possible laboratory experiment of SASI.

8HE.00042 Non-relativistic collisionless shocks in unmagnetized electron-proton plasmas, TSUNEHIKO KATO, YASUHIRO KURAMITSU, YOUCHI SAKAWA, HIDEKI TAKABE, ILE, Osaka University, Japan. — We show that collisionless shocks with non-relativistic propagation speed can be driven even in unmagnetized electron-proton plasmas by using two-dimensional particle-in-cell simulations. We performed a series of simulations for flow velocities of 0.9c, 0.45c, 0.2c and 0.1c with a reduced proton to electron mass ratio of 20 and observed formation of collisionless shocks in all cases. In these shocks, the Weibel-type instability generates strong magnetic fields within the shock transition layer. The generated magnetic fields provide an effective dissipation mechanism for the upstream plasma which enables the shocks to form without background magnetic fields. Since non-relativistic shocks are frequently driven in weakly magnetized electron-proton plasmas in the universe associated with various astrophysical phenomena (e.g., supernova explosions), this kind of shocks mediated by the Weibel instability can exist in the universe. In addition, thanks to the self-similarity in the basic equations of collisionless plasma, there is a possibility to generate such shocks in a laboratory with high-power laser facilities by scaling the quantities.

8HE.00043 Relativistic Jets from Collapsars and its Energy Distribution, AKIRA MIZUTA, Chiba University. — The origin of some of long GRBs is believed to be supernovae. It is difficult to know the properties of progenitors. We perform relativistic hydrodynamic simulations of jet propagation in the collapsar and interstellar medium, using some possible progenitors developed by massive stellar evolution to study the dependence on the progenitor for the emmissivity from the jet. The the jet is well collimated in the progenitor, though the injected jet has some opening angles. The internal structure, such as internal shocks, is quite less, if the opening angle is not so small. Though the progenitors which we used in this study have different radius, total mass, mass distribution, etc. the energy distribution of jet in angle does not strongly depend on the properties of the progenitors after the jet break the progenitor.

8HE.00044 On the self-acceleration of fireshell, CARLO BIANCO, REMO RUFINI, GREGORY VERESHCHAGIN, SHE-SHENG XUE, ICRANet and University of Rome “Sapienza”. — The Fireshell in a Gamma-Ray Burst (GRB) has the most unique feature in the entire field of physics of self-accelerating from a Lorentz gamma factor equal to 1 all the way to 200-300. The hysics of this most extraordinary system is based on the continuous annihilation of electron-positron pairs in an optically thick e^+e^- plasma. The physical reasons for this self-acceleration reanalyzed and the fireshell dynamics is compared with the “fireball” solution usually adopted in GRB literature.
8HE.00045 Thermalization of the pair plasma and the consequences for Gamma-Ray Bursts, GREGORY VERESHCHAGIN, ALEXEY AKSENOV, REMO RUFFINI, ICRANet and University of Rome “Sapienza” — We consider initial conditions in the sources of Gamma-Ray Bursts. We show that hot and dense pair plasma, created in the source, relaxes to thermal equilibrium configuration with zero chemical potentials well before it starts to expand driven by the radiative pressure. The relaxation process follows the sequence: pairs, protons, photons, thus the first particles reaching the same temperature are electrons and positrons, while photons join the thermal math latest. We also show that light nuclear elements cannot be synthesized in the fireball.

8HE.00046 High Density Plasmas in Black Hole Candidates, ARI BRYNJOLFSSON, Applied Radiation Industries — While cosmological observations are progressing exceptionally well, the theoretical interpretation of the observations are becoming ever more difficult. The difficulties are mainly due to two fundamental misconceptions: 1. It is generally believed that most of the redshifts are due to Doppler shifts, while in fact most of them are due to plasma redshifts. 2. It is generally believed that photons have weight in the local system of reference, while photons actually are weightless. Eliminating these misconceptions changes in fundamental ways the cosmological perspective and facilitates explanation of great many phenomena that have been difficult to explain, including the physics of black hole candidates. The overlooked plasma-redshift cross-section gives an explanation of the cosmological redshift without “big bang”, “inflation”, “dark energy,” or “dark matter.” It also explains the cosmic microwave background, the X-ray background, and much more. There are no black holes due to the weightlessness of photons. Instead the black hole candidates are engines for conversion of burned out nuclear matter to hot and dense primordial matter, which assures continual renewal of the world.

8HE.00047 Static equilibrium configuration of two charges in General Relativity, VLADIMIR BELINSKI, GEORGE ALEKSEEV, ICRANet and University of Rome “Sapienza” — An asymptotically flat static solution of Einstein-Maxwell equations which describes the field of two Reissner-Nordstrom sources in equilibrium is presented. It is expressed in terms of physical parameters of the sources (their masses, charges and separating distance). Very simple analytical forms were found for the solution as well as for the equilibrium condition which guarantees the absence of any struts on the symmetry axis. This condition shows that the equilibrium is not possible for two black holes or for two naked singularities. However, in the case when one of the sources is a black hole and another one is a naked singularity, the equilibrium is possible at some distance separating the sources. It is interesting that for appropriately chosen parameters even a neutral Schwarzschild black hole can be “suspended” freely in the field of a naked singularity which phenomenon is due to the repulsive forces produced by a naked singularity.

8HE.00048 On the general theory for construction the static solutions for two charges in General Relativity, GEORGE ALEKSEEV, VLADIMIR BELINSKI, ICRANet and University of Rome “Sapienza” — In this talk we present a general family of static asymptotically flat solutions for the superposed gravitational and electromagnetic fields of two Reissner-Nordstrom sources with arbitrary parameters: masses, charges and separating distance. The Inverse Scattering Method for Einstein-Maxwell equations for stationary axisymmetric fields is outlined. The family of equilibrium configurations of two Reissner-Nordstrom sources (one of which should be a black hole and another one (a naked singularity) described in our first talk arises after a restriction of the parameters of the general solution presented here by the equilibrium condition which provides the absence in the solution of conical singularities on the symmetry axis between the sources.

8HE.00049 Lines of force in the Alekseev-Belinski solution, MARCO PIZZI, ARMANDO PAOLINO, ICRANet and University of Rome “Sapienza” — Recently Alekseev and Belinski have presented a new exact solution of the Einstein-Maxwell equations which describes two Reissner-Nordstrom (RN) sources in reciprocal equilibrium (no struts nor strings); one source is a naked singularity, the other is a black hole: this is the only possible configuration for separable objects, apart from the well-known Majumdar-Papapetrou case. We studied in some detail the coordinate systems used and the main features of the gravitational and electric fields of this solution. Classically-forbidden equilibria are also allowed by this new solution. In particular we show the plots of the electric force lines in the three qualitatively different equilibrium configurations: equal-signed charges, opposite charges and the case of a naked singularity near a neutral black hole.

8HE.00050 On the dyadotorus, CHRISTIAN CHERUBINI, ANDREA GERALICO, JORGE RUEDA, REMO RUFFINI, ICRANet and University of Rome “Sapienza” — The “dyadotorus” is defined as the region around a Kerr-Newman black hole where pair creation by vacuum polarization occurs. This concept extends to the case of stationary geometries the concept of “dyadosphere” already introduced in the static case in the Reissner-Nordstrom geometry. The energetics of the dyadotori, their topology and embedding diagrams are compared and contrasted to the ones of the black hole.

8HE.00051 Charged particles in the Reissner-Nordstrom geometry, DONATO BINI, ANDREA GERALICO, REMO RUFFINI, ICRANet and University of Rome “Sapienza” — The multiparticle problem of a two-body system consisting of a Reissner-Nordstrom black hole and a charged massive particle at rest is here solved by an exact perturbational solution of the full Einstein-Maxwell system of equations. The expressions of the metric and of the electromagnetic field, including the effects of the electromagnetically induced gravitational perturbation and of the gravitationally induced electromagnetic perturbation, are presented in closed analytic formulas. Particular attention is given to the analysis of the lines of force of the system formed by the black hole and the naked singularity describing the test particle. The new general relativistic effects leading to an electric Meissner effect are explored.

8HE.00052 The electrostatics of naked singularity, ANDREA GERALICO, DONATO BINI, REMO RUFFINI, ICRANet and University of Rome “Sapienza” — In order to further explore the physical reasons leading to an equilibrium configuration of a charged naked singularity in the field of the black hole the structure of the naked singularity and its mass energy are examined. Particular attention is given to define the physical achievable, stable equilibrium configurations.

8HE.00053 HED physics opportunities on OMEGA/OMEGA EP, DAVID MEYERHOFER, Laboratory for Laser Energetics, University of Rochester — The 60 beam, 30 kJ, OMEGA laser facility has been operating at the University of Rochester for more than a decade. The OMEGA EP laser facility adjacent to it will be completed in Q3FY08. OMEGA EP will consist of four beamlines with NIF-like architecture. Each of the beamlines will ultimately produce 10 ns 6.5 kJ energy ultraviolet pulses directed into the EP target chamber. Two of the beamlines will also operate as high energy petawatt (HEPW) lasers, with up to 2.6 kJ each in 10 ps IR pulses. The HEPW beams can be injected into either the EP chamber or the existing OMEGA target chamber for integrated experiments. This talk will describe the OMEGA EP project status, HED physics possibilities on the combined system, and opportunities for external user access. The ongoing OMEGA EP Use Planning process will be described. This work was supported by the U.S. D.O.E Office of Inertial Confinement Fusion under Cooperative Agreement No. DE-FC52-08NA28302.

8HE.00054 High-energy laser experiments on the Large Plasma Device1, CARMEN CONSTANTIN, ANDREW COLLETTE, SHREEKRISHNA TRIPATHI, PATRICK PRIBYL, ERIK EVERSON, ALEXANDRE GIGLIOTTI, STEVE VINCENTA, NATHAN KUGLAND, UCLA, RADU PRESURA, STEFAN NEFF, CHRISTOPHER PLECHATY, Univ. of Reno, Nevada, WALTER GEKELMAN, CHRISTOPH NIEMANN, UCLL — The interaction of a laser-plasma with a large magnetized plasma was studied with a high-energy laser at the Large Plasma Device. We will compare the magnetohydrodynamic response of the ambient plasma for a variety of plasma blow-off conditions as measured with an array of magnetic pickup and Langmuir probes.

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1 Work supported by the DOE and the Basic Plasma Facility
8HE.00055 Solid liner on plasma Magnetized Target Fusion physics demonstration. T.P. INTORATOR, Los Alamos National Laboratory, G.A. WURDEN, P.E. SIECK, W. WAGANAAR, M. KOSTORA, J. DEGNÁN, AFRL - Kirtland, L.E. RUDEN, C. GRABOWSKI, SAIC Albuquerque, M. DOMÓNKOS, W. SOMMARS, M. FRESE, Numerez, R.E. SIEMON, Univ. Nevada - Reno, T. AWE, A.G. LYNN, Univ. New Mexico, M. GILMORE — We summarize a Magnetized Target Fusion (MTF) effort, whose primary goal is the first integrated solid liner on plasma physics demonstration at Air Force Research Laboratory (AFRL) in 2008. The compression experiment at AFRL uses an aluminum, flux conserving shell, and a physics experiment at LANL defines the experimental design and diagnostic capabilities. The initial target plasma parameters are 400eV temperature, 3e22 m\(^{-3}\) density, and lifetime of 10 micro sec. Deformable contact vacuum liner experiments at the AFRL Shiva Star facility have demonstrated a shell kinetic energy of 1.5MJoule which stretches to maintain contact with the electrodes while the body of the liner glides radially inward to implode uniformly. The LANL FRXL experiment has a physics oriented front end with slotted liner, radial access for probes, optical diagnostics, and magnets.

1Supported by contract DE-AC52-06NA25396.

8HE.00056 Diagnostics for heavy ion beam driven Warm-dense-matter experiments. T.P. INTORATOR, BIENIOSEK FRANK, MATTHAEUS LEITNEN, WILLIAM WALDRON, Lawrence Berkeley National Laboratory — Intense heavy ion beams are an excellent tool to create large-volume samples of warm-dense-matter (WDM) with fairly uniform physical conditions. An extensive WDM experimental program is scheduled at LBNL where NDCX accelerator is used as a driver for heating metallic targets. This poster will focus on designing and implementation of diagnostics for a target. The diagnostics include a fast multi-channel optical pyrometer, absolutely calibrated streak camera-based spectrometer, Doppler-shift laser interferometer (VISAR) and fast gated CCD cameras. This equipment is capable of precise measurement of temperature starting from 2000 K, pressure in kbar region, and expansion velocities up to several km/sec. Temporal resolution of the diagnostic is on a sub-nanosecond time scale.

1This work performed under the auspices of the U.S. Department of En-

8HE.00057 Ideal Z-Pinch Instabilities Across Fluid Plasma Regimes. JOHN LOVERICH, AMMAR HAKIM, Tech-X Corporation — In this paper we model instabilities in high density Z-pinches across fluid plasma regimes. The theory of MHD instabilities in a Z-pinch plasma is well understood, in this paper we look at numerical predictions that extend well beyond MHD to a variety of high energy density fluid models. Currently, researchers at Tech-X are investigating Hall MHD, Two-Fluid and Gyroviscous models of plasma to properly model fast fluid plasma processes that are high density, but where the plasma size approaches the ion magnetization scale length. It is in this regime that electron drift velocities are high relative to the ion acoustic speed and a number of new instabilities begin to emerge that cannot be modeled with traditional MHD theory and where numerical methods are highly desirable for modeling the non-linear effects. Results are presented for Z-pinch simulations using ideal fluid models with comparison to MHD. In time, we hope to model other key effects such as radiation and ionization in addition to developing algorithms for better modeling the vacuum region.

8HE.00058 A Web 2.0 Interface to Ion Stopping Power and Other Physics Routines for High Energy Density Physics Applications. PETER STOLTZ, SETH VEITZER, Tech-X Corporation — We present a new Web 2.0-based interface to physics routines for High Energy Density Physics applications. These routines include models for ion stopping power, sputtering, secondary electron yields and energies, impact ionization cross sections, and atomic radiated power. The Web 2.0 interface allows users to easily explore the results of the models before using the routines within other codes or to analyze experimental results. We discuss how we used various Web 2.0 tools, including the Python 2.5, Django, and the Yahoo User Interface library. Finally, we demonstrate the interface by showing as an example the stopping power algorithms researchers are currently using within the Hydra code to analyze warm, dense matter experiments underway at the Neutralized Dist Compression Experiment facility at Lawrence Berkeley National Laboratory.

1This work supported by the DoE OFES through the SBIR program by grants DE-FG02-03ER83840 and DE-FG02-03ER83797

8HE.00059 Effects of a Center Wire on Conical Wire Array Z-Pinches. DAVID MARTINEZ, RADU PRESURA, LUCAS WANEX, Nevada Terawatt Facility, University of Nevada, Reno, DAVID AMPFLEDE, SANDIA NATIONAL LABORATORIES, ALBUQUERQUE, NM — Recent experiments have shown that plasma dynamics of conical wire arrays can help elucidate aspects of Z-pinch dynamics [Ampleford et al. J. Plas. Phys. 14 102704, (2007)]. At the Nevada Terawatt Facility we investigated the implosion dynamics of conical wire arrays with an additional wire located on the axis of the pinch. These experiments were conducted on Zebra, a 2 TW pulse power device capable of delivering a 1 MA current in 100 ns [Bauer et al, AIP Conf. Proc. 409, 153 (1997)]. Normally a conical wire array generically an imploding plasma with an axial velocity component. The additional center wire generates an axial current carrying plasma that serves as a target for the plasma accelerated from the outer wires, leading to the growth of the Kelvin-Helmholtz instability. This poster compares the dynamics and x-ray emission of the traditional and modified conical wire array pinches. In addition, we explore the effect of the center wire by including in the comparison cylindrical wire arrays with and without a center wire.

1Work supported by NNSA grant DE-FC52-06NA27616.

8HE.00060 Penetration of Conductive Plasma Across a Magnetic Field. CHRISTOPHER PLECHATY, Nevada Terrawatt Facility, University of Nevada, Reno, SANDRA WRIGHT, STEPHAN NEFF, PHILIPPE LEBLANC, RADU PRESURA, Nevada Terawatt Facility, University of Nevada, Reno — The mechanism which allows a conductive plasma to penetrate through a magnetic field, such as the penetration of the solar wind into the Earth’s magnetosphere, is still under debate. Several explanations exist which attempt to explain this phenomenon. Three such explanations are magnetic reconnection (Dungey 1961), a viscous-like interaction (Axford and Hines 1961), and a process called impulsive penetration (Lemaire and Roth 1978, Schmidt 1960). Experiments were performed at the Nevada Terrawatt Facility to investigate the interaction of an expanding, conductive plasma with an external magnetic field oriented perpendicular to the expansion direction. In these experiments, the plasma was observed to penetrate the magnetic field due to instabilities which formed on the boundary layer between the plasma and the magnetic field. The experimentally observed penetration mechanism will be compared with those previously listed. Work supported by DOE/NNSA grant DE-FC52-06NA27616.

8HE.00061 Laboratory Simulation of Instabilities in the Earth’s Magnetotail. SANDRA WRIGHT, RADU PRESURA, STEPHAN NEFF, CHRISTOPHER PLECHATY, PHILIPPE LEBLANC, Nevada Terrawatt Facility, University of Nevada, Reno — The solar wind crosses the magnetic field of the earth and mixes with the plasma of terrestrial origin. The fast particles from the solar wind are responsible for satellite damage, communication disruptions and power blackouts on earth. A better understanding of this penetration process is needed in order to be able to accurately predict it. One experiment attempting to accomplish this was performed at the Nevada Terrawatt Facility. This utilized the coupling of a short-pulse laser with a pulsed-power generator to study the interaction of a laser produced plasma with an independently produced magnetic field. The magnetic field induced a sheared flow along the boundary of the plasma plume which caused a Kelvin-Helmholtz instability similar to that found in the interaction between the solar wind and the magnetosphere that leads to the penetration of the fast particles. The instability produced in the experiment will be discussed along with its relevance to the solar wind/magnetosphere interaction.

1Work sponsored by DOE/NNSA grant DE-FC52-06NA27616.
8HE.00062 Magnetically accelerated foils for shock wave experiments\(^1\). STEPHAN NEFF, JESSICA FORD, DAVID MARTINEZ, CHRISTOPHER PLECHATY, SANDRA WRIGHT, RADU PRESURA, Nevada Terawatt Facility, University of Nevada, Reno — The interaction of shock waves with inhomogeneous media is important in many astrophysical problems, e.g. the role of shock compression in star formation. Using scaled experiments with inhomogeneous foam targets makes it possible to study relevant physics in the laboratory, to better understand the mechanisms of shock compression and to benchmark astrophysical simulation codes. Experiments with flyer-generated shock waves have been performed on the Z machine in Sandia. The Zebra accelerator at the Nevada Terawatt Facility (NTF) allows for complementary experiments with high repetition rate. First experiments on Zebra demonstrated flyer acceleration to sufficiently high velocities (around 2 km/s) and that laser shadowgraphy can image sound fronts in transparent targets. Based on this, we designed an optimized setup to improve the flyer parameters (higher speed and mass) to create shock waves in transparent media. Once x-ray backlighting with the Leopard laser at NTF is operational, we will switch to foam targets with parameters relevant for laboratory astrophysics.

\(^1\)Funded by NNSA grant DE-FC52-06NA27616.

8HE.00063 Progress in Ion Beam Driven High Energy Density Physics and Heavy Ion Fusion\(^1\). J.J. BARNARD, R.H. COHEN, A. FRIEDMAN, D.P. GROTE, S.M. LUND, L.J. PERKINS, W.M. SHARP, LLNL, B.G. LOGAN, J. ARMJO, F.M. BIENIOSEK, J.E. COLEMAN, E. HENESTROZA, E.P. LEE, M. LEITNER, R.M. MORE, P. NI, P.K. ROY, P.A. SEIDL, J.-L. VAY, W.L. WALDRON, A. ZYLSTRA, LBNL, R.C. DAVIDSON, PPPL, E.P. GILSON, LBNL, I. KAGANOVICH, H. QIN, PPPL — Recently, the U.S. heavy ion fusion science program has made significant experimental and theoretical progress in simultaneous transverse and longitudinal beam compression, ion-beam-driven warm dense matter and direct drive fusion target physics. First experiments combining radial and longitudinal compression of intense ion beams propagating through background plasma resulted in longitudinal compression by factors of over sixty and transverse focusing to focal spot sizes in which space charge effects have been virtually eliminated. These results are enabling ion beam target experiments at LBNL in 2008. We are theoretically investigating the physics of ion beam heated foils and metallic foams and the evolution of these targets. We are assessing how these new techniques apply to low cost modular drivers for inertial fusion energy.

\(^1\)This work was performed under the auspices of the U.S. DOE by LLNL under contract DE-AC52-07NA27344, by LBNL under DE-AC02-05CH1123 and by PPPL under DEAC02-76CH03073.

8HE.00064 High Energy-Density Plasma Production from Plasma-Filled Rod-Pinch Diodes\(^1\). J.W. SCHUMER, B.V. WEBER, D. MOSHER\(^2\), J.P. APRUZESE, Plasma Physics Division, Naval Research Laboratory — The Plasma-Filled Rod-Pinch diode (PFRP) concentrates a 100-ns, 500-kA, >MeV electron-beam onto the tip of a tapered tungsten rod, generating a High Energy Density Plasma (HEDP). The HEDP (warm dense plasma) is created by deposition of a high-power-density (40 TW/cm\(^2\)) electron-beam into solid-density tungsten. The diode current and voltage has been shown to be controllably modified between 260 kA and 1.8 MV to 770 kA and 0.45 MV by increasing the initial plasma-fill density. At the time of peak energy density, analytic estimates using a 0-d self-similar MHD model predict a solid-density (20 g/cm\(^3\)) tungsten plasma with 25 eV temperature, 16 Mbar pressure, and 2.4 MJ/cm\(^2\) thermal energy density prior to rapid plasma expansion (after about 10 ns). Temperature and ionization state increase after this time as the rod-tip rapidly expands. This PFRP approach may have advantages for HEDP research. Various applications include high-fluence flash radiography and the study of equation-of-state of materials. Current research results will be presented.

\(^1\)Supported by the US Office of Naval Research.

\(^2\)L-3 Communications, Reston, VA 20190

8HE.00065 3D MHD simulations of radial wire arrays\(^1\). C. JENNINGS, D. AMPLEFORD, Sandia National Laboratory, A. CIARDI, Observatorio de Paris, J. CHITTENDEN, S. BLAND, N. NIASSE, Imperial College — We present 3D resistive MHD simulations evaluating multi-MA radial wire arrays as a potential compact, high intensity source for inertial confinement fusion and laboratory astrophysics. A radial wire array consists of wires running radially outwards from a central electrode, and was first investigated at the 1 MA level on the MAGPIE generator at Imperial College. Originally used as a method of producing magnetic tower laboratory jets relevant to astrophysics\([1]\), they have also shown potential as a high power x-ray source. Able to produce x-ray pulses with a rise time and peak power comparable to cylindrical wire arrays, radial arrays occupy a smaller volume and may consequently be able to access higher power densities. We discuss simulation results reproducing radial array experiments performed on the MAGPIE facility as a means of benchmarking our model. This model is then used to evaluate radial wire arrays in the multi-MA regime for planned experiments on the Saturn generator of Sandia National Laboratories. \([1]\) A. Ciardi et al, Phys. Plasmas 14, 056501 (2007)

\(^1\)Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the US DOE’s NNSA under contract DE-AC04-94AL85000.

8HE.00066 Modeling double pulsing of ion beams for HEDP target heating experiments\(^1\). SETH VEITZER, Tech-X Corporation, JOHN BARNARD, Lawrence Livermore National Laboratory, PETER STOLTZ, Tech-X Corporation, ENRIQUE HENESTROZA, Lawrence Berkeley National Laboratory — Recent research on direct drive targets using heavy ion beams suggests optimal coupling will occur when the energy of the ions increases over the course of the pulse. In order to experimentally explore issues involving the interaction of the beam with the outflowing blowoff of target, double pulse experiments have been proposed whereby a first pulse heats a planar target producing an outflow of material, and a second pulse (\(~10\) ns later) of higher ion energy (and hence larger projected range) interacts with this outflow before reaching and further heating the target. We report here results for simulations of double pulsing experiments using HYDRA for beam and target parameters relevant to the proposed Neutralized Drift Compression Experiment (NDCX) II at LBNL.

\(^1\)The work of Tech-X personnel is funded by the Department of Energy under Small Business Innovation Research Contract No. DE-FG02-03ER83797.

8HE.00067 \(K_\beta\) conversion efficiency from rare gas jets irradiated by ultra short laser pulses

NATHAN KUGLAND, UCL\(A\) Physics, PAUL NEUMAYER, LLNL, ANDREW COLLETTE, CARMEN CONSTANTIN, UCL\(A\) Physics, EDWARD DEWALD, TILO DEOPPN, DUSTIN FROULA, LLNL, FREDERIC GIRARD, CEA, SIEGFRIED GLENZER, LLNL, ANDREA KRITCHER, UC Berkeley Nuclear Engineering, CHRISTOPH NIEHMANN, UCL\(A\) — The absolute laser conversion efficiency to \(K_\beta\)-like inner shell x-rays (integrated from \(K_\alpha\) to \(K_\beta\)) is observed to be an order of magnitude higher in argon gas jets than in solid targets due to enhanced emission from higher ionization stages following ultra short pulse laser irradiation. Excluding the higher ionization stages, the conversion efficiency to near-cold \(K_\alpha\) is the same in argon gas jets as in solid targets. In krypton gas jets, we present conversion efficiency exclusively into near-cold \(K_\alpha\) and \(K_\beta\). This work was performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory, through the Institute for Laser Science and Applications, under contract DE-AC52-07NA27344.
8HE.00068 Observations of Improvement in Conversion Efficiency to Laser Accelerated Protons Using Er-Hydrde Coated Targets1, D. OFFERMANN, L. VAN WOERKOM, R. FREEMAN, The Ohio State University, Columbus, OH, Y. PING, A.I. MACKINNON, A.G. MACPHEE, M.E. FOORD, J.I. SANCHEZ, N. SHEN, Lawrence Livermore National Laboratory, Livermore, CA, C.D. CHEN, Massachusetts Institute of Technology, Cambridge, MA — Using the Callisto Laser, at LLNL (8 J, 3 × 10^{19} W/cm^2) we have compared proton beams originating from contaminant layers on gold foil targets with beams from Gold targets coated with Er-H. Contaminants were removed using an Ar-ion etching beam. Data was collected using radiocronmic film and a Thomson spectrometer. An improvement of 23% in conversion efficiency for protons above 3MeV was observed due to Er-H. LSP simulations agree with this result when assumed that carbon ions in contaminants are predominantly He-like, as seen on the Thomson spectrometer. 

1This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

8HE.00069 Isochoric heating from fast electrons using mass limited targets. MICHEL KOENIG, Laboratoire LULI, SOPHIE BATO, PERCEVAL GUILLOU, PATRICK AUDEBERT, LIDOVIC LECHERBOURG, BENJAMIN BARBREL, SERNA BASTIANI-CECCOTTI, CHRISTOPHE ROUSSEAU, LAURENT GREMILLET, ERIK LEFEVRE, CEA Bruyères le Chatel, CHRISTINA BACK, General Atomic, PRAVESH PATEL, LLNL, TOM COWAN, University of Nevada, JENNY RASSUCHINE — Experiments to investigate fast electron transport in thin, mass-limited multilayer targets were performed at the LULI 100 TW laser facility. The targets were composed of V/Cu/Al and varied from 300 to 50 μm in diameter. They were isochorically heated by a 20 J, 300 ps laser pulse that delivered 1–2 × 10^{19} W/cm^2 to form a warm dense plasma. X-ray emission from the Cu and Al layers was measured using conical and spherical Bragg crystals. Time-resolved Kα emission spectra were also obtained using an ultra-fast streak camera indicating a total reflexing of the electrons. The data from targets of different size and/or Cu layer thickness are compared and analyzed to better understand the heating of the target and temperature of the plasma. Temperatures up to several hundred eV have been deduced from detailed spectra analysis. Comparison with PIC simulations will be presented.

8HE.00070 Hot Electron Generation in the Micro-Tipped Cone and Wedge Targets Irradiated with Ultra Intense Laserasts. BU. CHO, G.M. DYER, S. KNEIP, D.R. SYMES, A.C. BERNSTEIN, Texas Center for High Intensity Laser Science, The University of Texas at Austin, S. PIKUZ, Lomonosov Moscow State University, Russia, Y. SENTOKU, N. LE GALLOUCHE, T.E. COWAN, Nevada Terawatt Facility, University of Nevada at Reno, T. DITMIRE, Texas Center for High Intensity Laser Science, The University of Texas at Austin — By comparing Kα and bremsstrahlung x-rays yields, we have investigated hot electron generation from pyramidal-shaped reentrant micro-structured targets. We focused the THOR laser at the University of Texas at Austin (800nm, 40fs, 600mJ, 2 × 10^{19} W/cm^2 ) into these cone and wedge shaped targets with various polarizations. We find that hot electron production is highest in the wedge targets when irradiated with transverse polarization, though Kα is maximized with wedge targets and parallel polarization. These results are explained with particle-in-cell simulations.

8HE.00071 Electron transport in the tip of cone targets in high intensity laser-plasma interaction. NATHALIE LE GALLOUCHE, University of Nevada Reno, EMMANUEL D’HUMIERES, CPhT, Ecole Polytechnique, France, BYOUNG-IK CHO, University of Texas, Austin, JENS OSTERHOLZ, University of Düsseldorf, Germany, YASUHIKO SENTOKU, University of Nevada Reno, TODD DITMIRE, University of Texas, Austin — Cones targets of specific parameters were irradiated with the Thor laser (0.5J, 40fs, 800nm, 7micron focal spot. 3.10^{19} W/cm^2) at UT Austin. These targets have been diagnosed with a focus on hot electron transport especially in the tip. The results show a micron diameter beam exiting the outside tip after about 60 micron propagation in the bulk material of the tip itself. Key elements of the interaction will be presented along with supporting simulations.

8HE.00072 High Intensity Laser Coupling to a Cone Geometry for Fast Ignition1, R.B. STEPHENS, K.U. AKLI, General Atomics, A.J. MACKINNON, M.H. KEY, A. MACPHEE, Y. PING, Lawrence Livermore National Lab, D. OFFERMANN, D. CLARK, R.R. FREEMAN, T. LINK, V. OVCHINNIKOV, L. VANWOERKOM, The Ohio State U., T. BARTAL, F. BEG, S. CHAWLA, R.R. FREMAN, J.A. KING, T. MA, M.S. WEI, UCSD, C. CHEN, MIT, D. HEY, UC-Davis, Y. TSU, U. Alberta — The short -pulse laser, which ignites a fast ignition target, gains access to the compressed core through a reentrant cone that maintains a clear path through the blow-off plasma. The interaction of the laser with the cone surface is complex due to light and electron focusing by the cone walls. Furthermore, plasma produced by the prepulse can affect the interaction physics and electron transport. We report on experiments to study this, performed using Titan Laser facility (2×10^{20} W cm^-2). We imaged Cu Kα fluorescence in flat foils to show for the first time that the laser-generated electrons from glancing incidence light have no significant forward direction. Fluorescence images from cones support this conclusion, showing the electrons spread essentially randomly up to several hundred microns from a cone tip independent of focus conditions.

1Work was performed under the auspices of the US Department of Energy under DE-FG02-05ER54834 and W-7405-ENG-48.

8HE.00073 Analytical theory for the laser driven TNSA ion acceleration. MATTEO PASSONI, Dipartimento di Chimica Materiali e Ingegneria Chimica “G. Natta”, Politecnico di Milano, and Sezione di Milano INFN, Milan, Italy; MANZIO LONTANO, Istituto di Fisica del Plasma, C.N.R., Milan, Italy — Ions can be effectively accelerated during the interaction of an ultra-intense ultra-short laser pulse irradiating a thin solid target via the so-called Target Normal Sheath Acceleration (TNSA) mechanism. A theoretical model of the quasi-static electric field that is formed at the plasma-target interface is used to describe the maximum electric fields and the energy spectra of the ions accelerated in the field, making possible satisfactory comparisons with the most recent experimental and numerical data and predictions of regimes achievable in the future.

8HE.00074 Study of Acceleration, Transport and Dephasing of Hot Electrons in Solid Density Plasmas Irradiated with Ultra Intense Laser Pulses. B.I. CHO, Texas Center for High Intensity Laser Science, The University of Texas at Austin, J. OSTERHOLZ, Institute of Laser and Plasma physics, Heinrich-Heine-University, Düsseldorf, Germany, A.C. BERNSTEIN, G.M. DYER, T. DITMIRE, Texas Center for High Intensity Laser Science, The University of Texas at Austin — We have characterized the transport of hot electrons in solid targets by coherent transition radiation (CTR). CTR was observed from the rear side of aluminum foils irradiated with the THOR laser (800 nm, 40 fs, 600 mJ, 2 × 10^{19} W/cm^2) at the University of Texas at Austin. In the experiment, two distinct beams of hot electrons are emitted simultaneously from the target rear side. This observation shows that two different mechanisms, namely resonance absorption and Δ × B heating, accelerate the electrons at the target front side. These two distinct beams propagate through aluminum foils with different spatial and temporal characteristics and electron temperatures. The interpretation is confirmed by calculations of the electron acceleration and transport inside the target.
8HE.00075 Observation of Two-Beam Coupling between Intersecting Filament-Forming Beams in Air  
AARON BERNSTEIN, MATTHEW MCCORMICK, JAMES SANDERS, TODD DITMIRE, University of Texas at Austin, TEXAS CENTER FOR HIGH INTENSITY LASER SCIENCE TEAM — Controlling laser plasma filaments and their propagation is a major step toward their practical use in a variety of applications. Techniques typically rely on modifying beam launch conditions to optimize filament propagation. We present measurements of two-beam coupling between crossed filament-producing beams in ambient laboratory air, which may lead to scalable techniques for extending filament propagation dynamically. In the experiment, two pulses of less than 10 mJ and 80 fs duration were reflected off a 5 mm focal length mirror, and made to cross either before, at, or after the filament location. By imaging the beams after the filaments have diffractioned, energy transfers of +/-10% were measured. This energy transfer was controllable by a relative delay of +/-20 fs for the compressed pulse case. In addition to beam images, single-shot measurements were made of laser energy and spectra of one of the beams.

8HE.00076 Transport of Energy by Ultra-Intense Laser-Generated Electrons in Nail-Wire Targets1  
T. MA, J.A. KING, M.S. WEI, F.N. BEG, UCSD, K. AKLI, R.B. STEPHENS, General Atomics, S.P. HATCHETT, M.H. KEY, A.J. MACKINNON, A.G. MACPHEE, LNL, R.R. FREEMAN, L. VAN WOERKOM, OSU, J.S. GREEN, K.L. LANCASTER, P.A. NORREYS, RAL, W. THEOBALD, U. of Rochester, R. MASON, Research Applications Corporation — Understanding the transport of energy by relativistic fast electrons produced in petawatt (1015 W) laser matter interactions is one of the key challenges in fast ignition of ICF. A simple and small target (nail-wire) was designed to investigate aspects of this transport. Nail-wire targets were irradiated using the Vulcan Petawatt Laser (0.8 ps, 3x1019 W/cm2) at the Rutherford Appleton Laboratory. A Cu Kα spherically bent crystal image, a Highly Ordered Pyrolytic Graphite (HOPG) Spectrometer, and Single Photon Counting CCD were employed to make absolute Kα measurements. The penetration of hot electrons via the nail head into the bulk of the wire has been determined from the Kα data. XUV images (68 and 250 eV) indicate heating of a thin surface layer of the targets. A comparison of experimental results with the PIC/hybrid simulations using both LSP and e-PLAS will be presented at the meeting.

1Work performed under the auspices of US Dept of Energy contracts DE-FG02-05ER54834, W-7405-Eng-48 No. DE-FC02-04ER54789.

8HE.00077 Quantitative spatial information from K-alpha and XUV imagers in FI-related experiments with cone targets  
V.M. OVCHINNIKOV, D.W. SCHUMACHER, L. VAN WOERKOM, R.R. FREEMAN, The Ohio State University — The Fast Ignition (FI) concept for Inertial Confinement Fusion (ICF) relies on energetic electrons produced by laser-plasma interaction to deliver their energy into a pre-compressed fuel. Metallic cones are proposed as a way of protecting the incoming short pulse igniter laser from the compression. Currently cone structures are widely used to understand their effects on laser coupling to electrons. Typically, K-alpha and XUV two dimensional imaging diagnostics are used to obtain spatially resolved information of fast electron transport and protection within a target, respectively. Since these images only capture specific emission wavelengths, uncertainties arise as to the physical location of the emission within the target. We developed detailed optical models for these diagnostics to obtain computer-generated images of a cone target as it would appear in the image plane of each diagnostic. Superimposing these images with actual K-alpha and XUV experimental images allowed us to pinpoint the location of emission with respect to target boundaries. Sufficient knowledge of the target geometry along with the dimensions made it possible to map intensities from a 2D image onto a 3D cone surface thus reconstructing a 3D emission picture.

8HE.00078 Laser channeling in mm-scale underdense plasmas of fast ignition targets1  
C. REN, G. LI, R. YAN, University of Rochester, T.-L. WANG, J. TONGE, W.B. MORI, UCLA — In the fast ignition (FI) approach to Inertial Confinement Fusion (ICF) the energy of energetic electrons produced by laser-plasma interactions could cause significant energy loss for an ignition laser in an underdense plasma. One way to avoid this is to use a channeling pulse to create a low-density channel for the ignition pulse. Two dimensional Particle-in-cell simulations show that laser channeling in mm-scale underdense plasmas has many new phenomena that are not present in previous short-scale experiments and simulations, including plasma buildup to ne in front of the laser, laser hosing/refraction, channel bifurcation, and self-correction and electron heating to relativistic temperatures. The channeling speed is much less than the linear group velocity of the laser. The simulations find that low-intensity channeling pulses are preferred to minimize the required laser energy. The channel is also shown to significantly increase the transmission of an ion pulse.

8HE.00079 The ePLAS code for high-intensity laser-matter interaction studies1  
R.J. MASON, Research Applications Corporation, M. WEI, F. BEG, J. KING, UCSD, R. STEPHENS, General Atomics, J. FERNANDEZ, M. HEGELICH, Los Alamos National Lab — The 2-D implicit hybrid simulation code e-PLAS has been developed to study inertial fusion targets undergoing intense short pulse laser illumination over large problem space and time scales. It treats the background target plasma electrons as a collisional Eulerian fluid and the ions as either a fluid or PIC, particles-in-cell. Large state for hydrogen under high pressure is a key to understand the interior structure of gas giant planets like Jupiter. Uncertainty in the hydrogen EOS makes it difficult to estimate the mass of a central core in Jupiter, which can be an important clue to determine the formation scenario of our solar system. To obtain a more accurate EOS model, we have started to investigate the primary Hugoniot of liquid hydrogen by using the GEKKO XII laser. We adopt α-quartz as a standard material. Shock velocities in quartz and a sample are measured by VISAR. In this paper, we show the current status of our experiment and future plan.

8HE.00080 Shock Compression of Iron Foils Relevant to Earth Core Conditions with Intense Laser  
K. SHIGEMORI, Y. HIRONAKA, T. KADONO, K. OTANI, A. SHIROSHITA, ILE, Osaka Univ., T. IRIFUNE, N. OZAKI, K. MIYANISHI, T. ENDO, T. KIMURA, R. KODAMA, Grad. School of Eng., Osaka Univ., T. SAKAYA, T. KONO, Grad. School of Sci., Osaka Univ., K. SHIMIZU, Center for Quantum Science and Technology under Extreme Conditions, Osaka Univ., J. WARK, University of Oxford — Shock compression experiments were performed on GEKKO-XII/HIPER laser facility at ILE, Osaka University. Iron foils were irradiated to generate the pressure of Earth core (~350 GPa). We measured shock parameters with optical diagnostics, such as velocity interferometer system for any reflector (VISAR) and spectrally streaked optical pyrometer. We also measured with x-ray diffraction technique for determination of shock compressed crystal structure. Simultaneous measurements of optical diagnostics and x-ray diffraction were done for MgO and diamond crystal foils as well as iron foils.

8HE.00081 Laser-shock compression of liquid hydrogen and the interior structure of gas giant planets  
TAKAYOSHI SANO, Osaka University, MASASIRO IKOMA, KEIKUSA SHIGEMORI, NORIMASA OZAKI, TAKASHI ENDO, YOICHIRO HIRONAKA, YASUNORI HORI, AKIFUMI IWAMOTO, TOSHIHIKO KADONO, TOMOAKI KIMURA, RYOUSUKE KODAMA, KOHEI MIYANISHI, MITSUO NAKAI, TAKURO OKUCHI, KAZUTO OTANI, TATSUHIRO SAKAYA, KATSUYA SHIMIZU, AKIYUKI SHIROSHITA, HIDEKI TAKAHASHI — Equation of state for hydrogen under high pressure is a key to understand the interior structure of gas giant planets like Jupiter. Uncertainty in the hydrogen EOS makes it difficult to estimate the mass of a central core in Jupiter, which can be an important clue to determine the formation scenario of our solar system. To obtain a more accurate EOS model, we have started to investigate the primary Hugoniot of liquid hydrogen by using the GEKKO XII laser. We adopt α-quartz as a standard material. Shock velocities in quartz and a sample are measured by VISAR. In this paper, we show the current status of our experiment and future plan.
8HE.00082 Time-Resolved Third Order Harmonic Generation on Shocked Silicon Crystals. D.A. DALTON, W. GRIGSBY, H. QUEVEDO, A.C. BERNSTEIN, T. DITMIRE, Texas Center for High Intensity Laser Science, University of Texas—Austin — We are using nonlinear optical diagnostics to probe the shock-induced melt transition in silicon. Pump-probe shock experiments on [100] Si crystals were carried out using the Ti:Sapphire THOR laser (800 nm, 1 J, 600 ps-chirped, 40 fs-compressed). Two dimensional interferometry was used to map rear surface displacement at discrete times to infer a peak shock pressure. Third order harmonic generation (THG) is used to probe the bulk material’s long range order, while a reflectivity diagnostic is used in conjunction with the THG diagnostic to determine its validity. Preliminary evidence shows the anomalous response that at shock pressures < 100 kbar (=elastic limit) the THG signal does not decrease; however, at higher pressures of ~300-400 kbar the THG signal falls dramatically indicating fast crystalline disordering.

8HE.00083 Equation of State Measurements of Dense Plasmas Heated by Laser Accelerated MeV Protons. GILLISS OYER, AARON BERNSTEIN, BYOUNG-ICK CHO, WILL GRIGSBY, ALLEN DALTON, The University of Texas at Austin, RONNIE SHEPHERD, YUAN PING, HUI CHEN, KLAUS WIDMANN, Lawrence Livermore National Laboratory, JENS OZTERHOZ, Heinrich-Heine-University, TODD DITMIRE, The University of Texas at Austin — Using a fast proton beam generated with an ultra intense laser we have generated and measured the equation of state of solid density plasma at temperatures near 20 eV, a regime in which there have been few previous experimental measurements. The laser accelerated a directional, short pulse of MeV protons, which isochorically heated a solid slab of aluminum. Using two simultaneous, temporally resolved measurements, we are able to determine the equation of state of the Xe foil with picosecond time resolution. With these data we were able to confirm, to within 10%, the SESAME equation-of-state table in this dense plasma region.

8HE.00084 Probing the microscopic state of warm dense matter. G. GREGORI, Oxford University, B. BARBREL, A. BENUZZI-MOUNAIX, Ecole Polytechnique, C. BROWN, AWE, plc, R. CLARKE, Rutherford Appleton Laboratory, E. GARCIA SAIZ, Queens University, S. GLENZER, Lawrence Livermore National Laboratory, F. KHATTAK, Kohat University, D. NEELY, M. NOTLEY, Rutherford Appleton Laboratory, A. PELKA, TU Darmstadt, D. RILEY, Queens University, M. ROTH, TU Darmstadt, C. SPINDLOE, Rutherford Appleton Laboratory, M. KOENIG, Ecole Polytechnique — We have performed spectrally and angularly resolved x-ray scattering measurements in solid density plasmas produced by shock compression with a high power laser. The experiments have been performed at the VULCAN laser facility and at the LULI2000 facility. We have investigated warm and dense low-Z materials with particular regards to the regime where electron-ion correlation becomes important (i.e., the hydrodynamic regime). In these experiments, we used a secondary plasma to generate an intense source of x-ray radiation that is then scattered across the sample and observed in a forward scattering geometry and dispersed using a graphite Bragg spectrometer. The shock properties have been monitored with a dual color VISAR and streaked optical pyrometry, as well as with a XUV flat-field spectrometer. The inferred properties of the dense plasma from the scattering data are discussed and detailed comparison with statistical models of strongly coupled plasmas is reported.

8HE.00085 Destruction of nanograins by grain-grain collisions. NAOFUMI OHNISHI, Center for Research Strategy and Support, Tohoku University, EDUARDO BRINGA, BRUCE REMINGTON, GEORGE GILMER, ROGER MINICH, Lawrence Livermore National Laboratory, YASUTAKA YAMAGUCHI, Department of Mechanical Engineering, Osaka University, ALEXANDER TIELENS, NASA Ames Research Center — Atomistic simulations of grain-grain collisions have been carried out for spherical grains of 1.4 and 4 nm radii with relative velocities of 3.6–6.1 km/s and a number of random impact parameters. Since the initial grains are crystallites without any pre-existing defects, grain shattering due to nucleation of cracks was not observed in our simulations. We find grain fusion in some events, but generally melting occurs due to the small size of grain. The melting leads to nucleation, growth and linkage of voids in the melt, and finally small nanoscale clusters are produced through a web-like structure. The size distribution does not obey a single power law and can be considered as four different regimes in the cluster size.

8HE.00086 Brittle-to-Ductile Spall Transition in Laser Shocked Aluminum Alloys. D.A. DALTON, A.C. BERNSTEIN, University of Texas-Austin, J.L. BREWER, Stress Engineering Services, Inc., E.D. JACKSON, S. STEUCK, W. GRIGSBY, D. MILATHIANAKI, B. MURPHY, K. HOFFMANN, A. BENUZZI-MOUNAIX, Ecole Polytechnique, C. BROWN, AWE, plc, R. CLARKE, Rutherford Appleton Laboratory, E. GARCIA SAIZ, Queens University, S. GLENZER, Lawrence Livermore National Laboratory, F. KHATTAK, Kohat University, D. NEELY, M. NOTLEY, Rutherford Appleton Laboratory, A. PELKA, TU Darmstadt, D. RILEY, Queens University, M. ROTH, TU Darmstadt, C. SPINDLOE, Rutherford Appleton Laboratory, M. KOENIG, Ecole Polytechnique, E.M. TALEFF, T. DITMIRE, University of Texas-Austin — We have explored the role material microstructure plays on the spall strength of alloyed aluminum in the high strain rate range of 10⁶ to 10³ s⁻¹. We performed pump-probe style experiments using the Z-Beamlet Laser at Sandia National Laboratories to drive shocks in thin slabs of recyclatized Al–I₃ wt. pct. Mg. Velocity interferometry was used to measure the spall strength of the materials, and post-shot target analysis exploited high-speed peep-hole microscopy and Raman spectroscopy. Small cracks are produced through a web-like structure. The size distribution does not obey a single power law and can be considered as four different regimes in the cluster size.

8HE.00087 Ab initio simulation of the Helium Hugoniots up to very high temperatures. GILLES ZERAH, STEPHANE LEROUX, CEA-DAM Ile de France — The advent of very high energy lasers will allow probing extreme states of matter, and in particular inducing extremely strong shocks. These new experiments beg for the development of techniques capable of addressing these extreme states of matter using first principle techniques in order to probe our current understanding of physics in these regimes. In this paper, we consider First Principles Molecular Dynamics simulations, which have already shown to be a very powerful tool for dense plasmas simulations. Up to now these simulations were limited to temperatures up to approximately 10⁶K as a consequence of the very rapid growth of the number of electronic states when solving the Mermin-Kohn-Sham effective Schrödinger equation. In this work, we present a new technique, based on a direct evaluation of the density matrix, which bypasses the need to compute eigenstates and therefore allow simulation up to very high temperatures (here, up to 10⁶ eV). We apply this method to the computation of the Hugoniots curve of cryogenic Helium, and compare our results with Path Integral Monte Carlo simulations and recent experimental data.

8HE.00088 Study of the particles kinetic energy enhancement in explosions of atomic argon clusters driven by two-color three pulse intense laser. H.J. QUEVEDO, M. AVILA, T. DITMIRE, TCHILS - The University of Texas at Austin — A pump-probe experiment was designed to study the particle kinetic energy enhancement in the explosion of large argon clusters driven by high intensity lasers. The nano-plasma model has been effective in explaining laser-cluster interactions and the efficient absorption of laser energy by the cluster through resonant collisional heating. This resonance occurs when the electron density is similar to three times the critical density, enhancing the laser energy absorption by electrons. Previous experiments have shown the existence of this resonance achieving enhancement of the ions kinetic energy for an optimum delay between two laser pulses. In our experiment we attempt to reach the resonant condition two times to achieve extra absorption using a timed sequence of two intense red femtosecond pulses and one frequency double blue.

8HE.00089 Intense XUV radiation driven explosions of Xe clusters. B. MURPHY, K. HOFFMANN, A. BLOLIPETSKI, A. BERNSTEIN, J. KETO, T. DITMIRE, The University of Texas at Austin, I. ARTYUKOV, Lebedev Physical Institute — We have investigated the explosions of large xenon clusters subject to irradiation by high intensity extreme ultraviolet (XUV) light with wavelength near 38 nm. To do this we generated high order harmonics by focusing the output of the 20 TW, 40 fs, 800nm wavelength THOR laser into a jet of argon gas. To select a single harmonic we then employed a Sc/Si short focal length multilayer mirror optimized for the 21st harmonic at 38.1 nm at near normal incidence. This harmonic is focused onto a jet of xenon gas. We characterized the XUV focal spot by scanning a knife edge across an XUV photodiode and determined that our peak XUV intensity was 2x10²⁸ Wcm⁻². Fast ion time-of-flight spectra reveal high ion charge states well above single photon ionization thresholds. These ions exhibit low kinetic energies consistent with hydrodynamic cluster expansion rather than Coulomb explosion. We also measured the electron spectra from these Xe cluster explosions and have observed moderate energy electrons ejected from the clusters.
8HE.00090 Experimental evidence and theoretical analysis of photoionized plasma under x-ray radiation produced by intense laser\(^1\). FEILU WANG, National Astronomical Observatories, Chinese Academy of Sciences, SHINSUKE FUJIOKA, HIROAKI NISHIMURA, DALIJ KATO, YUTONG LI, GANG ZHAO, JIE ZHANG, HIDEAKI TAKABE — We composed a time-dependent detailed-configuration-accounting atomic model, which solves rate equations for level population distributions including collisional and radiative atomic processes based on the screened hydrogenic model (R. M. More, Handbook of Plasma Physics, vol. 3, Amsterdam: Elsevier Science Publishers, 1991). This model is used to interpret recent photoionization experiment on the large-scale laser system Gekko-XII (Yamanaka et al., 1981, IEEE, J. Quantum Electron. 17, 1639). In this experiment, the nitrogen gas was bathed in a Planckian radiation field of 80eV and was ionized beyond He-like state (open K-shell). It indicates the ionization parameter is around 10 erg cm/s under near steady-state conditions and the reasonable range of the electron temperature is 20-30eV. The comparison of synthetic and experimental spectra shows reasonable agreement and photoionization plays a significant role in this experiment.

\(^1\)The authors thank R. M. More and D. Salzmann for helpful discussions, J. K. Zhao and H. G. Wei for their support and Gekko-XII laser facility team for their technical assistance.

8HE.00091 Characterization of photoionized SiO2 aerogel plasmas created by radiation fields in gold hohlraum targets, YUTONG LI, JIE ZHANG, Institute of Physics, Chinese Academy of Sciences, ZHENGMING SHENG, XIN LU, QUANGLI DONG — The photoionized SiO2 aerogel plasmas generated under a near-Planckian radiation field in gold hohlraum targets irradiated by high power laser pulses are measured by observing the absorption spectra and line emissions in the range between 0.64 and 0.74 nm. The experimental results are simulated by theoretical calculations under local thermodynamic equilibrium (LTE) using a detailed-level-accounting (DLA) model. The contributions of different Si ions to the specific components of the measured absorption spectra are identified.

8HE.00092 The atomic number – charge relation in the nuclear matter in bulk, BARBARA PATRICELLI, MICHAEL ROTONDO, REMO RUFFINI, ICRANet and University of Rome “Sapienza” — We determine theoretically the atomic number (A)-charge relation in the nuclear matter in bulk with the model recently proposed by Ruffini et al. (2007). We compare this relation with the data of the Periodic Table, finding a very good agreement. Our relation also agrees with the semi-empirical one obtained from the Weizsacker mass formula up to A=10\(^5\). For higher values of A our relation has a different behaviour and we interpret this as a result of the penetration of electrons (initially confined in an external shell) inside the core that becomes more and more important by increasing the atomic number; these effects are not taken into account in the semi-empirical mass-formula.

8HE.00093 The extended nuclear matter model with smooth transition surface, JORGE RUEDA, BARBARA PATRICELLI, MICHAEL ROTONDO, REMO RUFFINI, ICRANet and University of Rome “Sapienza” — The existence of electric fields close to their critical value \(E_c=(m_e c^2)/(e\hbar)\) has been proved for massive cores of 10\(^7\) up to 10\(^7\) nucleons using a distribution of constant nuclear density and a sharp step function at its boundary. We explore the modifications of this effect by considering a smoother density profile with a proton distribution fulfilling a Wood-Saxon dependence. The occurrence of a critical field has been confirmed. We discuss how the location of the maximum of the electric field as well as its magnitude is modified by the smoother distribution.

8HE.00094 The relativistic Thomas-Fermi equation for extended nuclear matter, MICHAEL ROTONDO, SHE-SHENG XUE, ICRANet and University of Rome “Sapienza” — The derivation of the dimensionless form of the relativistic Thomas-Fermi equation for extended nuclear matter are described, taking into due account the process of inverse beta decay. The equations of the binding energy of such a configuration are also derived. The analogy and the differences between this treatment and the classical one by Greiner, Migdal, Popov and their schools are presented.

8HE.00095 Solutions of the ultra-relativistic Thomas-Fermi equation, MICHAEL ROTONDO, REMO RUFFINI, SHE-SHENG XUE, ICRANet and University of Rome “Sapienza” — The general solutions of a massive core at nuclear density are presented both from an analytic and numerical treatment. The analytic solutions generalize the solution introduced by Migdal, Volskerenskii and Popov in the case of heavy nuclei extending their treatment from Z\(^\text{max}\) all the way to Z\(^\text{max}\). Special attention is given to the energetics of these configurations. It is shown that the solutions obeying the condition of global neutrality are much more bound than the traditional ones adopting the condition of local neutrality. The relevance of these solutions for X-ray busters models is outlined.

8HE.00096 Ultra-intense laser driven high-energy K-\(\alpha\) sources for high-energy density experiments\(^1\). HYE-SOOK PARK, Lawrence Livermore National Lab — When a high-intensity short-pulse laser with the intensity \(>10^{17}\) W/cm\(^2\) illuminates a micro target, super-thermal to relativistic hot electrons are created along with the intense magnetic and electric fields. These hot electrons transports through the target material vacating and backfilling of the inner K-shell electrons creating K-\(\alpha\) photons. Utilizing this property, we are developing backlighters of energy \(>17\text{ keV}\) that are needed for many high energy density experiments on NIF and Omega-EP. We carried out experiments to demonstrate that high energy 1-D and 2-D radiography are possible using \(\mu\)-foil (\(\sim 5\mu\text{m thin}\)) and \(\mu\)-wire (10x10x300 \(\mu\text{m long}\)) targets attached to low-Z substrates [1]. We have tested Mo (17 keV), Ag (22 keV), Sm (40 keV) and Au (69 keV) backlighters using the Titan laser at LLNL and utilized them to radiograph laser driven samples. This paper will present our radiography results and K-\(\alpha\) source characteristics comparing them with the required signal level for NIF HED experiments.

\(^1\)This work was performed under the auspices of the Lawrence Livermore National Security, LLC; (LLNS)

8HE.00097 Status of High Energy Density Physics at GSI\(^2\). DIETER H.H. HOFFMANN, TU-Darmstadt — A detailed understanding of interaction phenomena of intense ion- and laser radiation with matter is important for a large number of applications in different fields of science, from basic research of plasma properties to application in energy science. Energy loss processes of heavy ions in plasma and cold matter are important for the generation of high energy density states in general and especially in the hot dense plasma of an inertial fusion target. Of special interest are phase transitions and the associated time scales when matter passes the warm dense matter regime of the phase diagram at high density but relatively low temperatures. We present an overview on recent results and developments of beam plasma, and beam matter interaction processes studied with heavy ion beams from the GSI accelerator facilities.

\(^2\)Supported by BMBF 06DA118
8HE.00098 Direct study of eos mixing laws through an orbital-free-molecular-dynamics point of view. FLAVIEN LAMBERT, JEAN-FRANCOIS DANIEL, LUC KAZANDJIAN, JEAN CLEROUIUN, CEA DIF — We have investigated eos mixing rules by an approach coupling consistently molecular dynamics for the nuclei and orbital free density functional theory for the electronic fluid. This framework allowed us to study, without mixing approximation, mixtures in the hot and dense regime — ie a plasma strongly coupled and partially degenerated —, regime relevant for inertial confinement fusion. Several mixtures borrowed from this field have been examined in order to both present the method and check the validity of eos mixing rules commonly used in hydrodynamics simulations.


8HE.00099 Rayleigh – Taylor instabilities and radiative cooling. SERGE BOUQUET, CEA-LUTH — The morphology and filamentary structure of old supernova remnants (SNR) — see for instance Crab Nebula — is still an open question. Rayleigh – Taylor instabilities (RTI) are suspected to play an important role in that structuration, however, as old SNR are optically thin, radiation can freely escape and local overdensifications can be produced. In this paper, we study the properties of media experiencing both RTI and radiative cooling. This work is performed analytically and numerically. In the analytical approach, the equations of the model are linearized and the key equation leading to the dispersion relation is derived. The structure of this key equation is studied and analytical solutions are provided in some special cases. The non linear phase of the radiative Rayleigh – Taylor instability (RRTI) is examined numerically. It is shown that compared to the pure RTI, RRTI alters the structure of heavy material spikes. The morphology of the mixing zone is also modified and the formation of overdense regions is evidenced.

8HE.00100 Scaling laws for radiative and magnetic fluids: pillar of laboratory astrophysics. EMERIC FALIZE, CEA-LUTH — In this work, we consider the fundamental problem of scaling laws in RMHD. The emergence of powerful facilities (Laser, Pinch devices and Spheromack) allows the study of dynamical evolution of plasmas with radiation and magnetic field. This kind of plasmas is very usual in astrophysical environments and it is very interesting for Astrophysicists to obtain similar plasma in laboratory. We explore regimes o(v/c) and o(v^2/c^2) approximation with an approach based on Lie groups which leads to a rigorous and systematic method to get scaling laws. We focus on the number of free parameters (in the different regimes) available to determine all the physical quantities related to the target and to the laser, but also on the astrophysical objects that can potentially reproduced in laboratory with nowadays (LULI2000, Omega, GekkoXII, LIL) and future (LMJ, NIF) laser facilities.

8HE.00101 Laser-Plasma simulations of Artificial Magnetosphere formed by Giant Coronal Mass Ejections1. YURI ZAKHAROV, ARNOLD PONOMARENKO, Institute of Laser Physics, Russia, KONSTANTIN VCHIVKOV, Institute of Laser Physics, WENDELL HORTON, PARRISH BRADY, University of Texas, ILP TEAM, UT TEAM — We study by the laboratory (Laser-Plasmas, LP) and numerical (3D/PIC-code) simulations a resulting state of very strong magnetopausé (MP) compression by CME with effective energy Eo > 10^41 ergs directed to the Earth. During probable formation of such Artificial Magnetosphere (AM) with the MP stand-off at Rm up to (2-3)R_E, a lot of catastrophic phenomena in a space and ground networks could occur due to very high curl electric fields induced by world-wide magnetic field’s changes with a SC-rate > 50 nT/s. The laboratory models of AM (with Rm ~ 0.1-30 cm) were formed around high-field, 1D and 3D magnetic obstacles, overflowing by LP-blobs with Eo up to kJ and magnetized ions. The shape and internal structure of such large-scale AM at KI-1 facility of Russian team were studied by a set of B-dot magnetic probes, while a main goal of UT’ small-AM experiment was to explore a possible shock’s generation and relevant electron accelerations. A preliminary results of KI-1 experiments show that the both Rm-size and SC(Eo) of AM could be described by modified Chapman-Ferraro Scaling, while the whole SC-distribution (in equatorial plane) by well-known “Image Dipole” model of the Earth magnetosphere.

1This work is supported by CRDF Grant # RUP2-2683-NO-05.

8HE.00102 Particle-in-cell (PIC) Simulations of Laser Plasma Interactions in Underdense Plasmas1. F.S. TSUNG, J. FAHLEN, B.J. WINJUM, J. TONGE, W.B. MORI. University of California, Los Angeles — In underdense plasmas, an incident laser can decay into a backward going electromagnetic wave and a forward going plasma wave (backward stimulated Raman scattering, or BSRS), or two counterpropagating plasma waves (2-p instability). These laser-plasma instabilities (LPI) can potentially reduce ICF yields either by preheating the target (through fast electrons generated by large amplitude plasma waves), or by reflecting the incident laser and thereby reducing the driver energy. We have studied these instabilities self-consistently using the electromagnetic PIC code OSIRIS, as well as with the electrostatic PIC code BEPS1 with external drivers. In this poster, we will present simulation results that address numerous kinetic aspects of these LPI under plasma parameters relevant to the National Ignition Facility (NIF), such as particle trapping due to large amplitude plasma waves, nonlinear frequency shifts which can detune and saturate the three wave interactions, and sideband instabilities resulting from trapped particles.

1Work supported by DOE and NSF.

8HE.00103 Fast Ignition with Ultra-High-Intensity Lasers1. J. TONGE, J. MAY, W.B. MORI, F.S. TSUNG, UCLA, C. REN, University of Rochester, M. MARTI, L. SILVA, Instituto Superior Técnico — Energy transport within overdense plasma with a fast ignition target is explored by examining the interaction of different intensity ignition lasers with a 50 µm radius target using two-dimensional Particle-In-Cell simulation. In fast ignition schemes the ignition energy must be delivered to a small region (~20 µm in radius) of dense plasma within the target in order to create a localized region where fusion occurs. The electron stopping length in the core and the energy spectrum of the ignition electrons determines the depth of this region. This depth is sensitive to the spectrum of the energy flux of fast electrons generated as a function of laser intensity at the critical surface. Coupled with current assumptions of the spectrum of electrons generated by high intensity lasers this limits ignition laser intensity to 5x10^14 W/cm^2. Our simulations show that the peak energy flux of the ignition electrons is significantly lowered as the electrons traverse the collisionless plasma from the critical density surface of the plasma to the high density target core where ignition occurs. This allows higher intensity lasers to be used thus delivering power to a narrower region. In addition we find that a higher percentage of the ignition lasers energy is delivered to the core with the higher intensity laser.

1Work Supported by Fusion Science Center for Extreme States of Matter.
8HE.00104 Experimental results to study astrophysical plasma jets using Intense Lasers. B. LOUPIAS, LULI, France, E. FALIZE, CEA, France, C.D. GREGORY, LULI, France, D. SEICHI, Graduate School of Engineering, Japan, T. VINCI, LULI, France, J. WAUGH, University of York, U.K., M. KOENIG, LULI, France, N.C. WOOLSEY, University of York, U.K., N. OSAKI, Graduate School of Engineering, Japan, A. BENUZZI-MOUNAIX, LULI, France, S. BOUQUET, C. MICHAUT, LUTH, France, M. RABEC LE GOAHEC, LULI, France, W. NAZAROV, University of St. Andrews, UK, S. PIKUZ, A. FAENOV, MISDC, Moscow, Russia, Y. KURAMITSU, Graduate School of Engineering, Japan, S. ATZENI, A. SCHIAVI, La Sapienza, Italy, Y. SAKAWA, H. TAKABE, R. KODAMA, Graduate School of Engineering, Japan — We will present our experimental characterization of a jet generation in vacuum using foam filled cone target and intense laser. The obtained results on shape, time evolution, temperature and density, are in good agreements with 2D simulations. We also compared these measurements with theory and astronomical observations. Further study, with ambient gas, simulating the interstellar medium, to evaluate its effect on the above plasma jet evolution have been performed. We will demonstrate the importance to implement several diagnostics to measure the required parameters to infer the dimensionless astrophysical numbers.

8HE.00105 Study of Hot Electron Propagation in Low Density Foams in Ultra Intense Laser Pulse Interaction. B. RAMAKRISHNA, P.A. WILSON, K. QUINN, L. ROMAGNANI, M. BORGHESI, The Queen’s University of Belfast, UK, A. PIPAHL, O. WILLI, Heinrich Heine Universität, Germany, L. LANCIA, J. FUCHS, Ecole Polytechnique, France, M. NOTLEY, R.J. CLARKE, Rutherford Appleton Laboratory — Ultrashort bursts of high energy charged particles produced from high intensity laser matter interactions have many potential applications in advanced science and technology areas. A vital application of laser produced MeV electrons is in inertial confinement fusion [1]. Scaling laws for the fast electrons produced during ultrahigh intensity interactions give electron temperatures $K_{\text{Thot}} \sim (1/2)^{10} \text{Wcm}^2 \text{m}^{-2}$. With up to 30% of the laser energy converted into these relativistic electrons. Electric effects may cause a reduction of the range of fast electrons as compared to what is predicted taking into account collisional effects only. These arise from the electric field $E$ generated by charge separation and by inductive effects, as the fast electrons propagate into the target. These electrons carry a current density $J_{\text{hot}}$ of magnitude which can be as large as $10^{12} \text{A/cm}^2$. The electric field $E$ depends on the conductivity $\sigma$ of the target material, because a return current balancing the current of fast electron must be set up to maintain quasi-neutrality (i.e. $J_{\text{hot}} + J_{\text{return}} \approx 0$) and allow propagation [2]. We present here recent results obtained from experiments carried out in the Petawatt laser facility at the Rutherford Appleton Laboratory.

5:30PM - Session F1 APS: Welcome Reception and Poster Session I (5:30-6:45 p.m.) Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Fourth Floor Lobby

F1.00001 PARTICLES AND FIELDS POSTERS —

F1.00002 Status report of the ANTARES Neutrino Telescope. COREY REED, Centre de Physique des Particules de Marseille (France), VINCENZO FLAMINIO, Physics Dept., Pisa University and INFN-Pisa (Italy) — The ANTARES collaboration is building a high energy neutrino telescope in the Mediterranean sea, 40 km off La Seyne sur mer in France. The goal of the experiment is to detect high-energy cosmic neutrinos using a 3D array of 900 photomultipliers held by 12 strings. The detection principle relies on the observation, using photomultipliers, of the Cherenkov light emitted by charged leptons induced by neutrino interactions in the surrounding detector medium. Since December 2007, the ANTARES detector comprises 10 strings, a total of 750 optical detectors, connected to the shore via an underwater cable from the site at a depth of 2475 m. First studies of the detector performance are detailed and preliminary results for the reconstruction of downward going cosmic ray muons as well as the observation upward going neutrino candidates are presented.

On behalf of the ANTARES collaboration.

F1.00003 $\nu_e$ Appearance Results from MiniBooNE. GEORGIA KARAGIORGI, Columbia University, MINIBOONE COLLABORATION — The MiniBooNE experiment at Fermi National Accelerator Laboratory recently published initial results for a search for $\nu_e$ appearance in a predominantly $\nu_\mu$ beam. No evidence for $\nu_e$ appearance was found at higher reconstructed neutrino energies, however, an excess was observed at low energies. An update on the $\nu_e$ appearance analysis will be given.

F1.00004 Flux and Inclusive Cross Section measurement in the MINOS Near Detector. DEBDDATA BHATTACHARYA, University of Pittsburgh, MINOS COLLABORATION — The MINOS experiment has been recording beam neutrino interactions in the near and the far detector since March 2005 using the high-intensity NUMI beam. The near detector data sample has millions of events in the 1-50 GeV range. The shape of the inclusive cross-section as a function of energy can be extracted from the total charged current sample. We collect muon antineutrino data as well which is about 6% of the NUMI beam. This enables us to also extract the shape of the antineutrino inclusive cross-section. Understanding the neutrino cross section in the given energy range will be important both for MINOS and for the next generation neutrino oscillation experiments (T2K, NOµA).

F1.00005 Electron Neutrino Background Analysis for the MINOS Near Detector. GREGORY PAWLOSKI, Stanford University — The MINOS experiment has the potential to observe electron neutrino appearance for a set of oscillation parameters that has not been excluded by the CHOOZ experiment. However, the observation of this hypothetical signal relies on an accurate understanding of the backgrounds. In order to understand these backgrounds, an analysis of the MINOS near detector energy spectrum, which contains no oscillated signal, is utilized. The results of this analysis can then be extrapolated to the far detector to yield the background estimate. The details and results of this near detector analysis are discussed.

F1.00006 Cross Section Measurement in MIPP. YUSUF GUNAYDIN, University of Iowa, MAIN INJECTOR PARTICLE PRODUCTION EXPERIMENT-FNAL-E907 COLLABORATION — The Main Injector Particle Production (MIPP) Experiment (FNAL-E907) is a fixed target experiment at Fermilab. The purpose of the experiment is to measure hadronic particle production using primary 120 GeV/c protons and secondary $\pi^\pm$, $K^\pm$, $p^\pm$ beams and target nuclei spanning the periodic table from hydrogen to uranium. Particle identification uses a Time Projection Chamber (TPC), Time of Flight (TOF), Threshold Cherenkov (TOV), and Ring Imaging Cherenkov (RIC) detectors in a wide range of particle momenta from 5 GeV/c up to 120 GeV/c. We present the status of data analysis to determine cross sections of 58 GeV/c $\pi/K/p$ beams on a thin carbon target.
F1.00007 Three flavor oscillation analysis of atmospheric neutrinos in Super-Kamiokande. ROGER WENDELL, SUPER-KAMIOKANDE COLLABORATION — Recently the flavor composition of the neutrino mass states has been measured with increasing precision. However, the $\nu_\mu$ component of the third state, controlled by the mixing angle $\theta_{13}$, together with the ordering of the neutrino masses remain unknown issues. Under the normal (inverted) hierarchy there is known resonant enhancement (suppression) of the $\nu_{\mu} \to \nu_e$ three-flavor oscillation probability in matter for several GeV neutrinos with long baselines when $\theta_{13} > 0$. Conversely, anti-neutrinos experience suppression (enhancement). Expanding the standard oscillation analysis to incorporate all active neutrino flavors, Super-Kamiokande (SK) can exploit this asymmetry to address these open questions. The SK-I and II atmospheric neutrino data has been combined and fit under a three-flavor oscillation model for both hierarchies. The results are consistent with previous analyses and zero $\theta_{13}$.

F1.00008 First 5 Tower CDMS Analysis Results. CATHERINE BAILEY, Case Western Reserve University, CDMS COLLABORATION — The Cryogenic Dark Matter Search (CDMS) is searching for Weakly Interacting Massive Particles (WIMPs) with low-temperature detectors that have the ability to discriminate between candidate (nuclear recoil) and background (electron recoil) events with extremely high accuracy. The CDMS II experiment has completed analysis of the first data run with all 30 semiconductor detectors at the Soudan Underground Laboratory. This talk will present an overview of the experiment along with the analysis results, with a focus on the data quality studies that remove outlier events.

F1.00009 The XENON100 Dark Matter Experiment: Initial Performance and Projected Sensitivity. ELENA APRILE, Columbia University, XENON COLLABORATION — The XENON Dark Matter Project aims at the direct detection of WIMPs (Weakly Interacting Massive Particles) with dual phase (liquid/gas) xenon time projection chambers (LXeTPCs). Following the successful performance of the XENON10 detector, which has shown in 2007 the best sensitivity to spin-independent coupling of WIMPs to matter, we have designed and completed the construction of a new TPC with an active LXe shield, containing a total of 150 kg of xenon. The detector, mounted in the same passive shield used for XENON10 at the Gran Sasso Underground Laboratory, is currently undergoing gamma calibration. Based on a similar design as XENON10, XENON100 features an increase in fiducial target mass of a factor of 10, with an overall background rate about 100 times lower. We report on the status of this development and discuss the projected sensitivity reach for dark matter detection.

F1.00010 Indirect Dark Matter Searches with VERITAS. MATTHEW WOOD, UCLA, VERITAS COLLABORATION — If dark matter (DM) is composed of massive, weakly-interacting particles such as the neutralino predicted by supersymmetry, pair annihilation to gamma rays or secondary particles ultimately producing a continuum spectrum of gamma rays may take place in gravitationally clustered DM. Due to their large mass-to-light ratios and the absence of conventional gamma-ray sources in their vicinity, dwarf spheroidal galaxies of the Local Group are obvious targets to search for such annihilation. We report here on gamma-ray observations taken with the Very Energetic Radiation Imaging Telescope Array System (VERITAS) during the 2007/8 season of the dwarf galaxies Ursa Minor, Draco, and Willman I and the local group galaxy M33. We discuss the implications of these measurements for models of DM clustering and DM particle properties.

F1.00011 The MICE Experiment. ULISSÉ BRAVAR, University of New Hampshire, MICE COLLABORATION — The International Muon Ionization Cooling Experiment (MICE) was designed to demonstrate the ionization cooling of muons for the first time, a process in which the emittance of a muon beam is reduced in a very limited time frame, compatible with the short lifetime of muons. Ionization cooling represents a fundamental step in the construction of high intensity muon accelerators, e.g. for a Neutrino Factory of Muon Collider. MICE will reduce 6D emittance of muon beams over a range of beam momenta from 140 to 240 MeV/c over a 5.5 m long cooling channel with various magnetic field configurations and measure that reduction. The muon beam will be extracted from pions produced at a dedicated beamline at the ISIS source at Rutherford Appleton Laboratory in the UK. The MICE beamline is presently in the final stages of commissioning. Measurements will begin in early 2008 with first results becoming available later during the year.

F1.00012 Antiproton Experiments for Fermilab’s Future. DANIEL KAPLAN, Illinois Institute of Technology — The world’s most intense antiproton source is at Fermilab, and all of the antiprotons it produces are used by the Tevatron Collider. Anticipating the 2009 shutdown of the Tevatron (when the LHC is expected to surpass the Tevatron physics reach), we are preparing a proposal for a new experiment at the Fermilab antiproton source. The proposed program includes precision measurements of charmonium and the recently discovered charmonium-related states, sensitive searches for symmetry violations in the hyperon sector, and charm mixing and possible CP violation. Some supersymmetric models predict large deviations from Standard Model expectations in hyperons or charm; these can be tested in such a program.

F1.00013 Prospects for a High-Sensitivity Lepton Flavor-Violating Search at Fermilab. ROBERT BERNSTEIN, Fermilab, MUSE COLLABORATION — The mu2e collaboration proposes to search for coherent, neutrinoless conversion of muons into electrons in the field of a nucleus with a sensitivity improvement of a factor of 10,000 over existing limits. Such a lepton flavor-violating reaction probes new physics at a scale unavailable by direct searches at either present or planned high energy colliders. The physics motivation for mu2e will be presented, as well as the design of the muon beamline and spectrometer. A scheme by which the experiment can be mounted in the present Fermilab accelerator complex will be described. Prospects for increased sensitivity using the Project X linac that is being proposed by Fermilab will be discussed.

F1.00014 Recent Operational Experience and Future Plans for the Cornell Electron Storage Ring. JAMES CRITTENDEN, Cornell University, CESR OPERATIONS GROUP TEAM — Operation of the Cornell Electron Storage Ring CESR for the production of charm quark bound states from 2002 to 2008 has resulted in world-record data sets of decays of $\psi(2s)$, $\psi(3770)$ and $D_s^*$ mesons. The CESR-c project required the resolution of a unique array of accelerator physics problems associated with the dynamics of counter-circulating $e^+ e^-$ beams in a single beam pipe and with the damping-dominated optics which were a necessary consequence of employing twelve wiggler magnets to reduce the damping time from 500 ms to 50 ms. We discuss performance limits and operational experience obtained during the six years of operation of CESR as a charm factory. Future plans for CESR, including its continued operation as a synchrotron light source, its near-term conversion to an ILC damping ring R&D testbed, and its use as an essential component for a proposed Energy Recovery Linac will be presented as well.

\footnote{Work supported by the National Science Foundation.
F1.00015 CMS Tracker Detector Performance Studies, JOANA ANGHEL, University of Illinois, Chicago, CMS COLLABORATION — The Compact Muon Solenoid (CMS) is scheduled to start taking data in 2008 at the CERN Large Hadron Collider (LHC), in Geneva, Switzerland. The inner tracker system of CMS is designed to provide a precise and efficient measurement of the trajectories of charged particles emerging from the LHC collisions, as well as a precise reconstruction of secondary vertices, which is crucial in the identification of a jet as arising from a b-quark. This ability many physics studies, from the search of the low-mass Higgs boson to studies of the top quark and physics beyond the standard model, to be very promising. The CMS Silicon Strip Tracker is by far the largest semiconductor silicon detector ever constructed. All of the systems were fully commissioned in 2007 during which five million cosmic ray tracks were recorded. We developed a tool to analyze the data taken during this time to identify noisy and dead channels based on the information provided by the Data Quality Monitoring system (DQM). The excellent performance of the tracker is seen from the small fractions of bad channels and the stability of the system when operating at different temperatures.

F1.00016 Overview of recent $D^0$ mixing results from the Babar experiment, JON COLEMAN, Stanford Linear Accelerator Center, BABAR COLLABORATION — During 2007 both BaBar and Belle surprised the physics community with unexpected results in charm mixing. Since this time there has been several confirmations of this phenomena. We will present an overview of recent results from the BaBar experiment at BaBar.

F1.00017 Measurements of Partial Branching Fractions for $\bar{B} \rightarrow X_u \ell \bar{\nu}$ and Determination of $|V_{ub}|$ at BaBar, MICHAEL SIGAMANI, Queen Mary, University of London, BABAR COLLABORATION — We present partial branching fractions for inclusive charmless semileptonic $B$ decays $\bar{B} \rightarrow X_u \ell \bar{\nu}$, and the determination of the CKM matrix element $|V_{ub}|$. The analysis is based on a sample of 383 million $Y(4S)$ decays into $BB$ pairs collected with the BaBar detector at the PEP-II $e^+e^-$ storage rings. $\ U(1S) \rightarrow BB$ events are tagged by the full reconstruction of a hadronic decay of one of the $B$ mesons. Signal $\bar{B} \rightarrow X_u \ell \bar{\nu}$ is then identified looking at several kinematic variables. The corresponding value of $|V_{ub}|$ is extracted.

F1.00018 Study of $B$ decays to two-body final states with $\eta$, $\eta'$, $\omega$, and $\pi^0$ mesons, JACOB GILMAN, University of Colorado, BABAR COLLABORATION — We present preliminary measurements of the branching fractions of $B$ meson decays to charmless two-body final states with $\eta$, $\eta'$, $\omega$, and $\pi^0$ mesons. Knowledge of these decay rates constrains some of the strong-interaction corrections to CP asymmetries in decays such as $B^0 \rightarrow \eta K^0$. The data were collected with the BABAR detector at the PEP II asymmetric collider at SLAC.

F1.00019 Measurements of the Mass and Width of the $D_1(2420)$ and the $D_1^*(2460)$, JOSE FELICIANO BENITEZ, Stanford Linear Accelerator Center, BABAR COLLABORATION — The copious inclusive production of charm mesons in the BaBar detector at the PEP-II B-factory enables detailed investigation of the spectroscopy of charm meson states decaying to a $D^*$ and at least one pion. We will present preliminary high precision measurements of the mass and width values of the $D_1(2420)$ and the $D_1^*(2460)$, observed in the decay to $D^*\pi$.

F1.00020 ABSTRACT  Withdrawn

F1.00021 Improved measurement of the branching fraction, polarization, and $CP$ asymmetry in $B^+ \rightarrow \rho^0 \rho^+$ decays, ZAFAR YASIN, University of California Riverside, BABAR COLLABORATION — Based on data collected at the $\ U(1S)$ resonance by the Babar detector at the PEP-II asymmetric-energy $e^+e^-$ storage rings at SLAC, we present an improved measurement of the $B^+ \rightarrow \rho^0 \rho^+$ branching fraction, polarization, and direct $CP$ asymmetry. These results can be used to improve the determination of the CKM unitarity angle $\alpha$.

F1.00022 Measurement of the differential top cross section $(d\sigma/dM_{\ell\ell})$ at CDF, ALICE BRIDGEMAN, University of Illinois at Urbana-Champaign, CDF COLLABORATION — We present a measurement of the $t\bar{t}$ differential cross section $d\sigma/dM_{\ell\ell}$ at $\sqrt{s} = 1.96$ TeV using approximately 1.9 fb$^{-1}$ of data collected with the CDF II Detector at the Fermilab Tevatron. We select events in the $W^+ + 1 or 2$ jets sample with displaced secondary vertices from jets with heavy-flavor decays. We use a regularized unfolding technique to correct the reconstructed invariant mass distribution back to the true distribution. We see no evidence of inconsistency with the standard model, with an observed p-value of 0.45.

F1.00023 Search for Chargino-Neutralino Production with Triseleton Data at CDF, MARCELO VOGEL, JOHN STROLOGAS, MICHAEL GOLD, The University of New Mexico, CDF COLLABORATION — Chargino-neutralino production is one of the most promising SUSY signals that could be observed at the Tevatron. Cross sections of the order of 0.1 pb have not been excluded yet, under the mSUGRA scenario, and the characteristic trilepton signature is not contaminated by significant standard model backgrounds. We present a search for associated production of the lightest chargino and the next-to-lightest neutralino in multi-lepton final states using 2.3 fb$^{-1}$ of 1.96 TeV $p-\bar{p}$ data collected by the CDF-II detector at the Fermilab Tevatron.

F1.00024 Measurement of the W Boson Helicity in Top Quark Decay at D0, AMITABHA DAS, University of Arizona, D0 COLLABORATION — We report on a model-independent measurement of the helicity of W bosons produced in top quark decays based on a 1 fb$^{-1}$ sample of tbar events in the dilepton and lepton+ jets channels. In the standard model, the fraction of longitudinal (right-handed) W bosons is predicted to be 0.7 (0). The deviation from these values would be a clear sign of new physics. The measurement is based upon the angle between the momenta of the down-type fermion and the top quark in the W boson rest frame.

F1.00025 Search for Flavor Changing Neutral Currents in Top Decays at CDF, ALEXANDER PARANOV, HENRY FRISCH, University of Chicago, CDF COLLABORATION — We present a direct upper limit on the branching ratio of the flavor-changing top quark decay $t \rightarrow Zc$ using 1.5 pb$^{-1}$ of $pp$ collision data. We parametrize the upper limit as a function of the Z boson’s helicity to cover the full range of possible decay structures. The analysis is based on the comparison of two processes: $pp \rightarrow t\bar{t} \rightarrow WbWb \rightarrow l\ell'\ell\bar{\nu}_{\ell'}$ and $pp \rightarrow t\bar{t} \rightarrow ZcWb \rightarrow l^+l^-\ell\nu\nu$. The use of these two decay modes together allows cancellation of dominant systematic uncertainties on acceptance, efficiency, and luminosity. We validate the MC modeling of acceptance and efficiency for lepton identification over the multi-year dataset with a measurement of the ratio of the inclusive production of W and Z bosons. The upper limit on the $Br(t \rightarrow Zc)$ is estimated from a simultaneous fit to the $l^+l^-\ell\nu\nu$ mass distribution and the number of lepton + $\mathcal{E}_{T}$ + 4 jets events.
temperatures. Estimates of permanent shadow areas range from 5300 km² to 7500 km² for the north pole and 3300 km² to 6500 km² for the south pole. These regions provide an environment suitable for the storage of water ice due to their relatively low constant surface and subsurface temperatures. Estimates of permanent shadow areas range from 5300 km² to 7500 km² for the north pole and 3300 km² to 6500 km² for the south pole.

F1.00027 Search for Higgs Bosons Produced in association with W bosons at CDF
JASON SLAUNWHITE, RICHARD HUGHES, The Ohio State University, CDF COLLABORATION — We present a search for the Higgs boson decaying to b\bar{b} pairs and produced in association with a W boson in pp collisions at sqrt(s) = 1.96 TeV. We searched a dataset corresponding to an integrated luminosity of 1.9 fb⁻¹. Our candidate events have one high-pT muon or electron, missing ET, and two jets. We increased the purity of our sample by using advanced techniques to identify several categories of jets with b-quarks. We further improved our discrimination of Higgs signal from W+jet backgrounds through the use of an artificial neural network. We combined our searches in the separate tag categories and set a 95% Confidence Level upper limit on the production cross section times branching ratio.

F1.00028 Single Top Quark Production at D0 in the Muon Decay Channel using Boosted Decision Trees
JORGE BENITEZ, Michigan State University, D0 COLLABORATION — Protons and antiprotons are collided at the Fermilab Tevatron at a center of mass energy of 1.96 TeV. We have performed a search for single top quark production in these collisions using a dataset of 2.2 fb⁻¹ collected with the D0 detector in the muon+jets channel. This analysis utilizes secondary-vertex tagging to identify jets originating from b-quarks. It probes the muon+jets decay mode, where the W boson from the top quark decays into a muon and a neutrino. We present results from the application of boosted decision trees to separate the expected signals from backgrounds.

F1.00029 Search for singletop production at CDF using a multivariate likelihood method
SARAH BUDD, University of Illinois at Urbana-Champaign, CDF COLLABORATION — The electroweak production of single top quarks has been sought after since the discovery of the top quark more than 10 years ago. The measurement of the cross section for single top quarks provides sensitivity to the CKM phase V_{tb} and is sensitive to various models of physics beyond the standard model. We present new results from the search for single top quark production using 2 fb⁻¹ of data accumulated with the CDF detector. We select events with one charged lepton, large missing transverse energy, and two jets, where one jet is identified as a b-quark jet using displaced secondary-vertex information from the CDF silicon detector at the Fermilab Tevatron. Results are given using a multivariate likelihood function, used to search for s-channel and t-channel single-top production as well as the combined process.

F1.00030 Measurement of the Top Quark Mass at D0 Using the Matrix Weighting Method on Dilepton Events
DANIEL BOLINE, Boston University, D0 COLLABORATION — We present a measurement of the top quark mass in the dilepton channel based on approximately 1 fb⁻¹ of data collected by the D0 experiment during Run II of the Fermilab Tevatron collider. The kinematics of these events are not sufficiently constrained by the observed final state to reconstruct the top quark mass. We therefore compute a likelihood for the observed events to occur for a range of assumed top quark masses. For each event we choose the hypothesized top quark mass at which this likelihood is maximized as the estimator for the top quark mass. We compare the distribution of this estimator for all events to Monte Carlo predictions for different input top quark masses in a maximum likelihood fit to extract the top quark mass.

F1.00031 Measurement of the top quark mass in the lepton+jets channel using quantities that are independent of the jet energy scale at CDF
FORD GARBERSON, University of California, Santa Barbara, CDF COLLABORATION — We will present two techniques for measuring the top quark mass in the lepton plus jets channel using quantities independent of the jet energy scale. One technique exploits the correlation of the transverse decay length of b-tagged jets with the top quark mass, and the other exploits the correlation of the transverse momentum of the lepton in the same events with the top quark mass. While these results are still statistically limited, their precision will improve with added data at the Tevatron and the LHC. Further, since their correlation to more conventional top quark mass measurement techniques is small, they will help to reduce the overall uncertainty on the top mass in combination with other results.

F1.00032 Measurement of the Charge Asymmetry in Top Production in Proton-Antiproton Collisions at D0
AMNON HAREL, University of Rochester, D0 COLLABORATION — We report on the first measurement of the forward-backward asymmetry in top quark production in proton-antiproton collisions based on 0.9 fb⁻¹ of data. If the component of the top quark momentum along the proton direction is larger than that of antitop the asymmetry is defined as positive and negative otherwise. Top and antitop momenta are reconstructed in lepton+jets sample using b-tagging information and kinematic constraints.

F1.00033 Measurement of the top quark mass using the matrix element analysis technique in the lepton + jets channel with in situ W calibration at CDF
DARYL HARE, Rutgers University, CDF COLLABORATION — We present a top quark mass measurement from pp collisions at CDF. We use events from pp to tt in the lepton+jets channel requiring one charged lepton, high missing transverse energy and at least 4 jets, at least one of which must be identified as a b-jet. The top quark mass is extracted with a 2D unbinned likelihood fit using per-event probabilities calculated using leading-order signal (tt) and background (W+jets) matrix elements. The probabilities are a function of both the top quark mass and the energy scale of the calorimeter jets (JES) which is measured in-situ by constraining the invariant mass of two hadronic jets to the W boson mass.

F1.00034 UNDERGRADUATE RESEARCH POSTERS —

F1.00035 LRO, LEND and the Search for Water on the Moon
JESUS CANTU, Undergraduate, New Mexico State University — This presentation is an overview of the Lunar Emitted Neutron Detector (LEND) mission aboard the Lunar Reconnaissance Orbiter (LRO), scheduled for launch by NASA in October 2008. Instruments aboard LRO will map the lunar surface in unprecedented detail. LEND is a collimated epithermal neutron detector developed in Russia under the direction of Igor Mitrofanov and will measure the lunar neutron albedo. A decrease in epithermal neutron count rates is associated with the presence of surface and subsurface hydrogen. It is postulated that at least some of the hydrogen present in permanently shadowed regions is in the form of water ice. The Moon’s spin axis is inclined at 1.5 degrees to the ecliptic plane which can result in unusual lighting conditions at the lunar poles. Data from Lunar Prospector and Clementine indicate the presence of water ice in permanently shadowed areas at low elevations of impact craters near the poles. These regions provide an environment suitable for the storage of water ice due to their relatively low constant surface and subsurface temperatures. Estimates of permanent shadow areas range from 5300 km² to 7500 km² for the north pole and 3300 km² to 6500 km² for the south pole.

1Research made possible by SPS and MU-SPIN
Studies of rare decays as well as these precision measurements also open a window on to possible new physics beyond the Standard Model. Data sets in excess of 3 fb$^{-1}$ provide a unique opportunity to investigate the structure of flavor dynamics, QCD, and weak decays, including CP violation. The physics and properties of the most massive quark that forms bound hadronic states and the study of hadrons containing bottom quarks provides deep insight into many facets of the Standard Model: the structure of flavor dynamics, QCD, and weak decays, including CP violation. The physics and properties of bottom hadrons as measured by the Tevatron experiments CDF and DØ are reviewed. Particular emphasis is placed on the more massive $b$ hadron states not accessible at $B$ factories running at the $T(4S)$. Data sets in excess of 3 fb$^{-1}$ allow increased precision for detailed studies of $b$ hadron production, spectroscopy, lifetimes, neutral $B$ meson oscillations, and CP violation. Studies of rare decays as well as these precision measurements also open a window on to possible new physics beyond the Standard Model.

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**Monday, April 14, 2008 7:00PM - 9:00PM**

Session H3 DNP: The Long Distance Structure of the Nucleon  
Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis E

9:42AM H2.00003 $B$ Hadron Physics at the Tevatron

RICK VAN KOOTEN, Indiana University — The $b$ quark is the most massive quark that forms bound hadronic states and the study of hadrons containing $b$ quarks provides deep insight into many facets of the Standard Model: the structure of flavor dynamics, QCD, and weak decays, including CP violation. The physics and properties of $b$ hadrons as measured by the Tevatron experiments CDF and DØ are reviewed. Particular emphasis is placed on the more massive $b$ hadron states not accessible at $B$ factories running at the $T(4S)$. Data sets in excess of 3 fb$^{-1}$ allow increased precision for detailed studies of $b$ hadron production, spectroscopy, lifetimes, neutral $B$ meson oscillations, and CP violation. Studies of rare decays as well as these precision measurements also open a window on to possible new physics beyond the Standard Model.

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**Monday, April 14, 2008 9:00PM - 9:40PM**

Session H4 DNP: Hadrons and Quarkonia

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis E

9:40PM H4.00001 Hadrons and Quarkonia at the CDF

JESSICA HANZLIK, THE OHIO STATE UNIVERSITY, THE COLLIDER DETECTOR AT FERMILAB COLLABORATION — The search for the Higgs boson is of great interest, with a variety of searches ongoing at the CDF and DØ experiments at the Tevatron at Fermilab, as well as planned searches in the upcoming LHC detectors ATLAS and CMS. At Fermilab, one primary mode for a low mass Higgs is via $ZH$ production. In this channel, the $Z$ boson ($Z$) decays into a lepton pair, and the Higgs boson ($H$) decays into a bottom quark and an anti-bottom quark pair. The leptons can be accurately detected and measured, whereas the quarks decay into jets, which are more difficult to measure accurately. This analysis investigates the use of the precise measurements of the leptons to improve the measurement of the individual jets, and thus the determination of the resulting Higgs mass. The method we investigate involves the use of Artificial Neural Networks. We present expected improvements in Higgs mass resolution at CDF.

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**Tuesday, April 15, 2008 7:00PM - 9:00PM**

Session H5 DNP: Hadrons and Quarkonia

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis E

9:40PM H5.00001 Hadronic B decay at the Tevatron

1 Representing the CDF and DØ Collaborations

**Tuesday, April 15, 2008 9:00PM - 9:40PM**

Session H6 DNP: Hadrons and Quarkonia

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis E

9:40PM H6.00001 Heavy Quark Spectroscopy at the Tevatron1

1 Representing the CDF and DØ Collaborations
8:30AM H3.00001 Long-Distance Nucleon Structure: Theoretical Overview\(^1\), T. WILLIAM DONNELLY, MIT — The electroweak form factors of the nucleon will be discussed, including the electromagnetic form factors extracted from parity-conserving electron scattering from the proton and from light nuclei, the axial-vector form factor from weak interaction studies and the strangeness form factors which can play a role in parity-violating electron scattering. The focus will be placed on what can be learned about the long-distance structure of the nucleon. Several issues of interpretation will also be discussed: higher-order electroweak contributions, problems of interpretation in coordinate space and uncertainties which arise in the case of the neutron where inevitably nuclear structure problems arise.

\(^1\)Work supported in part by the U.S. Department of Energy Office of Nuclear Physics under contract No. DE-FG02-94ER40818.

9:06AM H3.00002 Elastic form factor measurements at Mainz\(^2\), THOMAS WALCHER, Mainz University — The precision of measurements of the form factors of the nucleon has greatly improved over the last decade. At large four-momentum transfers \(Q^2\) the new investigations at Jlab have shown highly significant deviations from the celebrated dipole shape considered until recently as a prove of the vector dominance model. At low \(Q^2\) the possibility of a long wave length bump/dip structure has stirred a controversy. In a visual picture in the Breit frame such a structure would indicate a charge contribution extending out to radii larger than 1 fm at variance with some popular models of the nucleon. But, such a charge would also be in clear contradiction to the best dispersion relation description. In this talk a summary of this situation will be given and new yet unpublished results from the Mainz Microtron MAMI for the electric form factor of the proton aiming at a clarification of the bump/dip structure will be presented. It shows that the low as well as the high \(Q^2\) data are important for the study of the long distance structure of the nucleon.

9:42AM H3.00003 New Results from BLAST at MIT-Bates\(^1\), CHRISTOPHER CRAWFORD, University of Kentucky — The BLAST experiment was designed to study in a systematic manner the spin-dependent electromagnetic interaction on few-body nuclei. Utilizing the polarized electron beam in the MIT-Bates South Hall Storage Ring, highly-polarized isotopically pure targets of hydrogen and deuterium, and the symmetric toroidal BLAST detector; precise measurements have been made which permit the extraction of the proton and neutron electric and magnetic form factors. The neutron electric form factor especially is now known to a precision comparable to that of the other nucleon form factors. In this talk, I will present these measurements, as well as their transform into spatial coordinates.

\(^1\)This work is supported in part by the U.S. Department of Energy and the National Science Foundation.

Sunday, April 13, 2008 8:30AM - 10:18AM –
Session H4 DNP FEd: Undergraduate Education in Nuclear Physics

8:30AM H4.00001 Conference Experience for Undergraduates in the Division of Nuclear Physics - 10 Years Running , WARREN ROGERS, Westmont College — The Conference Experience for Undergraduates (CEU), held annually in the APS Division of Nuclear Physics since 1998, has become a valuable addition to the fall DNP meetings. Since its inception 10 years ago, approximately 730 undergraduate students from over 60 colleges and universities from around the country (and a few from abroad) have participated. The goal of the program is to provide students who have conducted undergraduate research in nuclear science a “capstone” conference experience, with the goal toward strengthening retention of talented students in the field. In addition to the main conference, the CEU includes extra activities for the students, including the main research poster session, two undergraduate nuclear physics seminars, and a graduate school information session. CEU application materials are considered by an independent review committee, and travel and lodging grants are awarded based on project merit. Financial support is provided by the NSF, DOE, and DNP. At the recent 10th anniversary CEU, a mini-symposium was organized as part of the DNP conference, at which former CEU students (now graduate students, post-docs, and professors) had opportunity to talk about their research and the influence that undergraduate research and conference participation had on their career paths. Survey and anecdotal data indicating benefits of CEU participation, as well as initial results from career path tracking will be presented.

9:06AM H4.00002 Research in an Undergraduate Physics Department\(^1\), JOHN SHRINER, Tennessee Technological University — In the 1970’s, a decision was made at Tennessee Technological University to emphasize nuclear physics as a research specialty in the department. Shortly thereafter, two of the department’s faculty began to include undergraduates in their experimental work, and such inclusion became a point of emphasis in the department. By the early 1990’s the department had nine faculty members, each with a background in nuclear physics. Six faculty had external funding from DOE, and including undergraduates in the research process was an important component in most of those grants. Today four of seven faculty are active in nuclear physics, and most of our majors (admittedly a small number) will have a summer research experience either through one of our own programs or through an REU program elsewhere before they graduate. I will discuss both positive and negative aspects of this choice to concentrate on a single subfield and offer my views on what it has meant for research in our department, for our students during their undergraduate years, and for future manpower in the field of nuclear physics.

\(^1\)Work supported in part by the US Department of Energy under grant DE-FG02-96ER40990.

9:42AM H4.00003 U.S. Workforce and Educational Facilities’ Readiness to Meet the Future Challenges of Nuclear Energy , SEKAZI MTINGWA, Massachusetts Institute of Technology — Using nuclear energy to generate electricity continues to be a topic of considerable debate. Currently, 20% of the electricity in the U.S. comes from its fleet of 104 commercial nuclear reactors, and they annually displace on the order of one hundred million metric tons of carbon emissions. These reactors currently account for 70% of the non-carbon emitting electricity production in the United States. Due to the recent interest by the Federal government and others in expanding the nuclear energy option, the American Physical Society’s Panel on Public Affairs sponsored a study of the U.S. workforce and educational facilities’ readiness for three scenarios out to the year 2050. They range from maintaining the current number of nuclear reactors, although some may be retired and replaced by new ones; significantly increasing the number of reactors, to perhaps as high as 200 or more; up to significantly increasing the number of reactors while closing the fuel cycle by reprocessing and recycling spent fuel. This talk reports on the results of that study.
8:30AM H5.00001 Pulsars, Magnetars, and Jets—Problems and Lessons for Astrophysical Plasma Physics  JONATHAN ARONS, University of California, Berkeley — Pulsars, magnetars and relativistic jets motivate investigations of plasma behavior well beyond the realms experimentally accessible in the laboratory or through in situ measurements in the heliosphere. Prominent among the areas of current research (the “known unknowns”) are the role of relativistic shock waves in converting ultrarelativistic flow energy into nonthermal particle spectra observed. I discuss aspects of what we know about this problem, along with where such acceleration physics is appropriate - essentially, to weakly magnetized flows. I also discuss the still less well understood strongly magnetized regime (magnetic energy density exceeding plasma rest energy density in the flow proper frame), where phenomenological models suggest that some form of magnetic dissipation, quite possibly mediated by current sheet formation, underlies the observed emissions. This dissipation also appears to play a role in the conversion of strongly magnetized flows into weakly magnetized, shock dominated systems, a special case of the relativistic magnetic dissipation problem which I will also address.

9:06AM H5.00002 Accretion Disks and Jets Around Black Holes  RAMESH NARAYAN, Harvard-Smithsonian Center for Astrophysics — Some of the most luminous objects in the universe involve accretion disks around black holes. In these systems, gas spirals into the black hole and converts a fraction of its gravitational binding energy into thermal energy and radiation. Sometimes, twin relativistic jets are ejected along the angular momentum axis of the disk. Understanding the physics of black hole accretion disks and jets is a major focus of modern astrophysics. Because the object at the center is a black hole, one must work with a relativistic theory. More importantly, one must allow for the effects of magnetic fields. These play an extremely important role, both in the extraction of angular momentum from the accreting gas — which is what allows the gas to fall into the hole — and in the launching, acceleration and collimation of the relativistic jets. Thus, at a minimum, one must work with the relativistic single-fluid MHD equations. The talk will briefly summarize our current understanding of black hole accretion, and outline some of the major unsolved problems.

9:42AM H5.00003 Some Things I Wished I Understood Better (or at all...)  ROBERT ROSNER, Univ. of Chicago/Argonne National Laboratory — Astrophysics has, since its very beginnings, sought to build our understanding of astronomical phenomena on the solid foundation of our understanding of physical phenomena in the terrestrial context. In areas such as spectroscopy, this approach has had outstanding success; but in other areas, making this connection in an intellectually rigorous way has proved to be very challenging. I will discuss some of the most troublesome examples, and offer some guidelines on how the resulting uncertainties in our understanding of the astrophysical phenomena can be circumscribed.

Sunday, April 13, 2008 8:30AM - 10:18AM —
Session H6 DPB FIP: Impact of Major Accelerator Projects on the Development of Emerging Countries  Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade D

8:30AM H6.00001 Indian Participation in LHC and a Glimpse of the Road Ahead  VINOD CHANDRA SAHNI, Raja Ramanna Centre for Advanced Technology, Indore-452013 & Bhabha Atomic Research Centre, Mumbai-400085, India — Indian high energy physicists have been using overseas research facilities for a long time especially those at CERN. In 1991, Indian DAE brought such collaborations under an institutional framework and entered into a 10 year cooperation agreement with CERN, which later helped India join the LHC program with an expanded objective. Besides participating in detector development and physics studies, India agreed to contribute to accelerator construction, where RRCAT (earlier known as CAT, Indore) was the lead Indian institution. The 1991 cooperation agreement was extended for another 10 years and new protocols were added enabling Indian participation in the LHC Computing Grid Developments and, recently, to Indian involvement in hardware for CLIC Test Facility 3 and LINAC-4. Successful India-CERN collaboration in accelerator construction has led to further Indian linkage to other international accelerator related projects such as FAIR and ILC. The talk will give an overview of the Indian contributions, benefits that have resulted through them, as well as a peek into collaborative programs for upcoming and also future projects.

9:06AM H6.00002 Impact of Pohang Accelerator on Large-scale Science Programs in Korea  WON NAMKUNG, POSTECH — Emerging countries pursue their industrialization based mainly on technology. However, governments of these countries often encounter difficulties pursuing a fast-track approach to advanced R&D programs due to a lack of resources, especially in trained man-power. There are a few successful countries, for example, in Korea. The government R&D budget has been increased by more than five-fold in the last decade in Korea, which has stimulated a large number of trained scientists and engineers to return home to Korea. Satisfied with positive results for industrialization based on R&D, the government has now begun to promote the basic science required for improving applied science and industries. At the same time, since the successful construction and operations of Pohang Light Source (PLS) initiated by POSTECH, the Korean government, and the steel company, POSCO, the Korean government has been promoting new large-scale scientific facilities for multi-disciplinary science, for example by joining the ITER tokamak project. This paper presents recent progress in and prospects for science and technology programs in Korea as an emerging country.

9:42AM H6.00003 The Impact of the SESAME Project on Science and Society in the Middle East  HERMAN WINICK, SLAC/SSRL/Stanford University — SESAME (Synchrontron-light for Experimental Science and Applications in the Middle East) is a UNESCO-sponsored project that is constructing an international research laboratory, closely modeled on CERN, in Jordan (www.sesame.org.jo). Ten Members of the governing Council (Bahrain, Cyprus, Egypt, Iran, Iraq, Israel, Jordan, Pakistan, Palestinian Authority, and Turkey) have responsibility for the project, led by Herwig Schopper, Council President since 1999. In late 2008 Chris Llewellyn-Smith will become Council President. SESAME was initiated by a gift from Germany of the decommissioned BESSY I facility. The BESSY I 0.8 GeV injector is now being installed in the recently completed building, funded by Jordan, as components are procured for a new 133 m circumference, 2.5 GeV third-generation storage ring with 12 locations for insertion devices. Beam line equipment has been provided by laboratories in France, UK, and US. Support also comes from EU, IAEA, ICTP, Japan Society for the Promotion of Science, the US Department of Energy and State Department, and laboratories around the world. The broad Scientific program includes biomedical, environmental, and archaeological programs particularly relevant to the Middle East. Five scientific workshops and six annual Users’ meetings have brought together several hundred scientists from the region, along with researchers from around the world. Training programs have enabled about 100 scientists from the region to work at synchrotron radiation laboratories. These activities have already had significant impact on science and society in the Middle East, for example leading to collaborations between scientists from countries that are not particularly friendly with each other, and to national planning emphasizing synchrotron radiation research. When research starts in 2011 this impact will grow as graduate students are trained in the region in many scientific disciplines, and scientists working abroad are attracted to return.

Sunday, April 13, 2008 8:30AM - 10:18AM —
Session H7 GGR: Laboratory and Space Tests of Gravitation  Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Rose Garden
8:30AM H7.00001 Pioneer Anomaly: Status of New Investigation, SLAVA G. TURYSHEV, Jet Propulsion Laboratory, California Institute of Technology — The Pioneer 10/11 spacecraft yielded the most precise navigation in deep space to date. However, their radiometric tracking data received from the distances between 20-70 astronomical units from the Sun has consistently indicated the presence of a small, anomalous, Doppler frequency drift. The drift is a blue frequency shift that can be interpreted as a sunward acceleration of \( a_F = (8.74 \pm 1.33) \times 10^{-10} \) m/s\(^2\) for each particular spacecraft. This signal has become known as the Pioneer anomaly the nature of which remains unexplained. New Pioneer 10 and 11 radio-meter Doppler data recently became available that span a longer interval compared to the data used in previous investigations. A thermal model of the Pioneer vehicles is being developed to study possible contribution of thermal recoil force acting on the two spacecraft. The current status of these investigations will be discussed. This work was carried out at the Jet Propulsion Laboratory, California Institute of Technology under a contract with the National Aeronautics and Space Administration.

9:06AM H7.00002 APOLLO: A Comprehensive Test of Gravity via Lunar Laser Ranging\(^1\), TOM MURPHY, UCSD — The fundamental incompatibility of quantum mechanics with general relativity together with our well-quantified ignorance of large-scale gravity (dark energy, dark matter) strongly suggests that we intensify our tests of gravity. APOLLO (the Apache Point Observatory Lunar Laser-ranging Operation) is a new project that will bring about order-of-magnitude improvements in testing several fundamental aspects of gravity. Using a 3.5 meter telescope to bounce laser pulses off of the retroreflector arrays left on the moon by the Apollo astronauts, APOLLO is capable of one-millimeter range-precision. By determining the exact shape of the lunar orbit, it will be possible to test the equivalence principle, the time-rate-of-change of the gravitational constant, gravitomagnetism, geodetic precession, and the inverse-square law to at least ten times better precision than currently tested. Details of the technique, millimeter-scale challenges, and performance to date will be presented.

\(^1\)Funding support from NSF PHY-0602507 and NASA NNX-07AH04G

9:42AM H7.00003 Precision Test of the Equivalence Principle\(^1\), JENS GUNDLACH, University of Washington — We used a torsion balance instrument installed on a continuously rotating turntable to measure the acceleration difference of beryllium and titanium test bodies towards sources at a variety of distances. Our result \( \Delta a_{\text{Be} - \text{Ti}} = (0.6 \pm 3.1) \times 10^{-15} \) m/s\(^2\) improves previous limits on equivalence-principle violations with ranges from 1 m to \( \infty \) by nearly an order of magnitude. The Eötvös parameter is \( \eta_{\text{Earth, Be-Ti}} = (0.3 \pm 1.8) \times 10^{-13} \). By analyzing our data for accelerations towards the center of the Milky Way we find equal attractions of Be and Ti towards galactic dark matter, yielding \( \eta_{\text{DM, Be-Ti}} = (-4 \pm 7) \times 10^{-5} \). Space-fixed differential accelerations in any direction are limited to less than \( 8.8 \times 10^{-15} \) m/s\(^2\) with 95% confidence.

\(^1\)This work was supported by NSF Grants PHY0355012,PHY0653863 and by NASA Grant NNC04GB03G.

Sunday, April 13, 2008 8:30AM - 9:30AM — Session H8 DAP: Galactic and Planetary Astrophysics

8:30AM H8.00001 The influence of Dynamical state on Scatter in Galaxy Cluster Mass- Observable Relations, HSIANG-YI YANG, PAUL RICKER, UIUC — Clusters of galaxies, as the most massive bound objects in the universe, are sensitive probes of the cosmological parameters. Determination of cluster mass is crucial and often relies on scaling relations between cluster mass and observables, such as X-ray temperature, X-ray luminosity, etc. Therefore, systematic bias and scatter in these relations have to be studied carefully both for cosmological purposes and for understanding complicated cluster physics. The dynamical state of clusters is one possible source of scatter, because most clusters are formed only recently by merging small galaxies or groups and many of the unrelaxed ones still show disturbed morphology in high-resolution X-ray images. In our work, we simulate galaxy clusters in cosmological simulations with dark matter particles and gas. We follow the actual cluster merging histories to quantify the dynamical state of clusters. To compare with observations more directly, we also produce mock Chandra images and extract X-ray observables in the same way observers do. There analyses allow us to examine contribution of dynamical state on scatter in cluster mass-observable relations.

8:42AM H8.00002 Can Cluster Evaporation Explain the Missing Thermal Energy in Galaxy Clusters\(^1\), MIKHAIL MEDVEDEV, University of Kansas — Recent observations of a number of galaxy clusters using the Sunyaev-Zel’dovich effect indicate that about 1/3 of baryonic mass is missing from the hot intracluster medium (ICM), which is significantly larger than the fraction of stars and cool gas, which account for only about 10%. Here we address the question whether the remaining 22% \( \pm 10% \) can be accounted for by thermal evaporation of gas from clusters. We have found that evaporation can occur only from the cluster "surface", \( r \sim r_{\text{vir}} \), and not from it’s interior. We evaluated particle diffusion through the magnetized ICM for several scenarios of ICM turbulence and found that diffusivity is suppressed by at least a factor of 100 or more, compared to the Spitzer value. Thus, only particles from radii \( r \gtrsim 0.9r_{\text{vir}} \) can evaporate. Diffusion of particles from inside the cluster, \( r \lesssim 0.9r_{\text{vir}} \), takes longer than the Hubble time. This lowers the cluster-averaged fraction of the evaporated hot gas to few percent or less. However, if the missing hot component is indeed due to evaporation, this strongly constrains the magnetic field structure in the cluster envelope, namely either (i) the gas is completely unmagnetized \((B < 10^{-21} \) gauss) in the cluster halo or (ii) the magnetic fields in the ICM are rather homogeneous and non-turbulent.

\(^1\)This work is supported by NASA, NSF and DOE

8:54AM H8.00003 Why are the earth spin and its axis 24hours, tilted by 23.5degree? SAHNGGI PARK, Electronics and Telecommunications Research Institute, 161 Kajong-Dong Yusong-Gu Taejon South Korea, 305-600 — The spins of planets have become a long subject of physics as well as the planetary science, and a lot of researches have been done mostly on the basis of the origin of the solar system, where the rotation rates of planets have been believed to be important clues to lead to the answer of question of planetary formations. Most studies reported in recent years discuss the rotation rate of a planet on the basically same kind of model where spin angular momentum was accreted from a disk of planetesimals at the early stage of planet formations. It is demonstrated that the earth spin is driven by a force induced from the gravitational and orbital motion of the earth-moon system, which leads the earth spin to be calculated from the fundamental quantities by almost an exact number, \( 23.518^\circ \pm 0.58^\circ \) without any adjusting constants. It is also demonstrated that the earth spin axis which is tilted by 23.5deg. with respect to the earth orbit can be derived from the gravitation of the sun acting on the earth. The calculated number, 23.487deg., is astonishingly close to the observation. The spin of the sun is also obtained by the same way as the earth by reducing the many body system into a two body system. The calculation results in an approximated number which validates our theory, analysis, and calculations. A possible experiment to measure the force driving the earth spin is discussed.
9:06AM H9.00004 Dark matter places matter , ORVIN WAGNER, Wagner Research Laboratory — Consider that the dark matter density (d) drops off as 1/r^2 from an oscillating, standing wave producing sun. The wave velocity is proportional to the reciprocal of the square root of d. The planet distances r=j/0.625N provides good values (N an integer equals 7 for Mercury). r_j is sun’s radius where relation applied to sun.1.25 m/s falls out of the calculations as the starting velocity for the waves from the sun. The relation also holds for satellites of oscillating gaseous planets. On earth a preliminary surface velocity is 5 m/s. See Physics Essays 12(1):3-10 (1999). Standing waves provide solar system stability. One can use the relation to get some history of the solar system and of the individual planets. For example the sun had a somewhat larger radius when the planets were placed. Apparently planets like Saturn used to be hotter with larger radii. These are determined from present satellite locations etc. One can arrive at reasonable layering of the gaseous planets considering that ring systems are due to ongoing layer oscillations. Sharp cutoffs of the rings indicate high Q oscillations instead of just gravity are involved. The data indicate that dark matter is not just a far away phenomenon but is involved on earth and is much more dense here than previously surmised.

9:18AM H9.00005 Ordinary Dark Matter versus Mysterious Dark Matter in Galactic Rotation , C.F. GALLO, JAMES FENG, Superconix Inc — To theoretically describe the measured rotational velocity curves of spiral galaxies, there are two different approaches and conclusions. (1) ORDINARY DARK MATTER. We assume Newtonian gravity/dynamics and successfully find (via computer) mass distributions in bulge/disk configurations that duplicate the measured rotational velocities. There is ordinary dark matter within the galactic disk towards the cooler periphery which has lower emissivity/opacity. There are no mysteries in this scenario based on verified physics. (2) MYSTERIOUS DARK MATTER. Others INaccurately assume there is the galactic halo and then the assumed light distribution and then the rotational velocity curves are NOT duplicated. To alleviate this discrepancy, speculations are invoked re “Massive Peripheral Spherical Halos of Mysterious Dark Matter.” But NO matter has been detected in this UNtenable Halo configuration. Many UNverified “Mysteries” are invoked as necessary and convenient. CONCLUSION. The first approach utilizing Newtonian gravity/dynamics and searching for the ordinary mass distributions within the galactic disk simulates reality and agrees with data.

Sunday, April 13, 2008 8:30AM - 10:18AM – Session H10 GGR: Numerical Simulations of Neutron Stars Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis A

8:30AM H10.00001 Magnetized Neutron Stars , STEVEN LIEBLING, Long Island University, MATTHEW ANDERSON, ERIC HIRSCHMANN, Brigham Young University, LUIS LEHNER, PATRICK MOTL, Louisiana State University, DAVID NEILSEN, Brigham Young University, CARLOS PALENZUELA, Albert Einstein Institute, JOEL TOHLINE, Louisiana State University — Magnetized neutron stars, whether considered individually or within compact binary systems, demonstrate a number of interesting dynamical effects. Using a distributed adaptive mesh refinement (AMR) code, we evolve such stars and study their dynamics.

8:42AM H10.00002 Collapse of magnetized hypermassive neutron stars in general relativity: Disk evolution and outflows , BRANSON STEPHENS, Princeton University, YUK TUNG LIU, STUART SHAPIRO, University of Illinois at Urbana-Champaign — We simulate the evolution in axisymmetry of accretion disks formed self-consistently through collapse of magnetized hypermassive neutron stars (HMNS) to black holes (BHs). Such stars can arise following the merger of binary neutron stars (NSs) and are secularly unstable to collapse due to MHD-driven angular momentum transport. The rotating BH which forms in this process is surrounded by a hot, massive, magnetized torus. Our code integrates the coupled Einstein-Maxwell-MHD equations and is used to follow the collapse of magnetized HMNSs in full GR until the spacetime settles down to a quasi-stationary state. We then employ the Cowling approximation, in which the spacetime is frozen, to track the subsequent evolution of the disk. This approximation allows us to greatly extend the disk evolutions and study the resulting outflows, which may be relevant to the generation of a gamma-ray burst. We find that outflows are suppressed when a stiff equation of state is assumed for low density disk material and are sensitive to the initial magnetic field configuration.

8:54AM H10.00003 A different way to evolve black hole-neutron star binaries , MATTHEW DUEZ, LAWRENCE KIDDER, SAUL TEUKOLSKY, Cornell University — We give a status report on our simulations of comparable mass black hole-neutron star binaries. We evolve the full Einstein equations for the spacetime metric using multidomain pseudospectral methods, and we evolve the hydrodynamic variables using finite volume methods on a separate grid. Our two-grid approach allows us to model the inspiral with particular accuracy.

9:06AM H10.00004 Evolution of Excised BHBBH and BHNS Initial Data: Numerical Methods and Tests , ZACHARIAH ETIENNE, JOSHUA FABER, YUK TUNG LIU, STUART SHAPIRO, KEISUKE TANIGUCHI, University of Illinois at Urbana-Champaign, THOMAS BAUMGARTE, Bowdoin College — We are now able to perform fully general relativistic simulations of black hole-black hole (BBBH) and black hole-neutron star (BHNS) binaries using conformal thin-sandwich (CTS) initial data and the BSSN-based moving puncture evolution technique. We fill the excised BH regions in the CTS initial data with smooth, constraint-violating “junk” data. To test this technique, we apply the junk-filling procedure to excised irrotational CTS BBH BBH initial data and evolve it. We compare the resulting waveform to that found using puncture initial data with the same initial orbital frequency and find good agreement. In our most recent work, this junk-filling technique is employed to stably evolve excised CTS BHNS binary initial data through inspiral, merger, and ringdown (t > 200 M). We present results from our BBNS simulations that validate our numerical technique and briefly outline future plans.

9:18AM H10.00005 Fully General Relativistic Simulations of black hole-neutron star Mergers , YUK TUNG LIU, ZACHARIAH ETIENNE, University of Illinois at Urbana-Champaign, JOSHUA FABER, Rochester Institute of Technology, STUART SHAPIRO, KEISUKE TANIGUCHI, University of Illinois at Urbana-Champaign, THOMAS BAUMGARTE, Bowdoin College — Black hole-neutron star (BHNS) binaries are expected to be among the leading sources of gravitational waves observable by ground-based detectors, and may be the progenitors of short-hard gamma ray bursts as well. We present our new fully general relativistic calculations of merging BHNS binaries, which use our recent conformal thin-sandwich (CTS) quasi-circular configurations as initial data. Our simulations are performed using a BSSN-based moving puncture method and a fully relativistic, high-resolution shock-capturing hydrodynamics scheme. We investigate the inspiral, merger, and disk formation in the systems. We find that the vast majority of material is promptly accreted and no more than 3% of the NS’s rest mass is ejected into a tenuous, gravitationally bound disk. We compute gravitational radiation, finding measurable differences between our waveforms and those produced by binary black hole mergers within the advanced LIGO band. These differences appear at frequencies corresponding to the onset of NS tidal disruption. The resulting information about the NS radius may be used to constrain the NS equation of state.

9:30AM H10.00006 Neutron Star Binary Coalescences: How realistic is the initial data? , RANDY WOLFMeyer, JIAN TAO, WAI-MO SUEN, HUI-MIN ZHANG, Washington University in St. Louis — Quasi-equilibrium approximations are often used as initial data for numerical simulations of binary neutron star inspiral coalescence. The standard is to begin the simulations at a separation close to that of the inner-most-stable-circular orbit. We examine how realistic it is to use quasi-equilibrium approximations at such close separations. Several measures of the validity are developed to determine what initial separation one must have for the quasi-equilibrium approximations to yield astrophysically realistic initial data.
9:42AM H10.00007 Critical Collapse of Non-Rotating and Rotating Neutron Star Systems with Axisymmetry, KE-JIAN JIN, WAI-MO SUEN, Washington University — GRAstro-2D is the package for simulation of system with axisymmetry. The convergence of this code is ensured. With this code we study the threshold of gravitational collapses of neutron stars. We find type I critical collapses in both non-rotating and rotating neutron star systems. Further, we show that a critical collapse may happen in a cooling process.

9:54AM H10.00008 Neutron Star Binary Coalescences: Angular Momentum Threshold Against a Prompt Collapse, HUI-MIN ZHANG, Washington University in St. Louis, JIAN TAO, Washington University in St. Louis, WAI-MO SUEN, MEW BING WAN, Washington University in St. Louis, RANDY WOLFMEYER, Washington University in St. Louis — We performed fully general relativistic simulations of neutron star binary coalescences to investigate how much angular momentum is needed to support the merged system against a prompt gravitational collapse. For a polytropic equation of state with the polytropic index in the range of $\Gamma = 2$ to 1.8, we find that the angular momentum threshold for an equal mass system can be described quite accurately by a simple formula $L/M^2 = M_{ADM}/M_{max}^{ADM}$, where $L$ is the total angular momentum of the binary neutron star system, $M$ is the total ADM mass of the system, $M_{ADM}$ is the ADM mass of the neutron star in isolation, and $M_{max}^{ADM}$ is the maximum ADM mass of a single neutron star with the same equation of state.

10:06AM H10.00009 Differentially rotating neutron stars: A perturbative study, ADAMANTIOS STAVRDIS, Washington University, St. Louis — We present a study of non-axisymmetric oscillations of differentially rotating neutron stars in the perturbative framework of General Relativity. Differential rotation plays an important role in nascent neutron stars, and recent numerical studies have shown that it can be responsible for an instability at low values of the ratio $T/W$. We study the oscillation spectrum of those stars and we investigate the possible effect of the existence of the corotation band on the low $T/W$ instability.

Supported in part by the National Science Foundation PHY 06-52448.

Sunday, April 13, 2008 8:30AM - 10:18AM –
Session H11 DPF: Muon Colliders and Nu Beams
Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis B

8:30AM H11.00001 Muon Beam Cooling and Muon Collider Prospects, KATSUBA YONEHARA, Fermilab, ROLLAND JOHNSON, Muons, Inc., YOROSLAV DERBENEV, Jlab — Progress in the theory and simulations of new cooling concepts and techniques has been substantial just in the last five years. New technologies that support high luminosity, high energy colliders have similarly shown great progress, especially in the development of high field magnets and RF cavities that can operate in the conditions of muon cooling channels. While these recent muon cooling developments have greatly improved the prospects for muon colliders, much work remains to achieve a complete design of a machine that could leap-frog the LHC to the next energy frontier. We report the status of muon cooling R&D, including demonstration experiments, and outline the next steps to an energy frontier lepton collider.

The work described here was supported in part by DOE SBIR/STTR grants DE-FG02-03ER83722, 04ER86191, 04ER84016, 05ER86252, 05ER86253 and 06ER86282.

8:42AM H11.00002 Muon Bunching and Phase-Energy Rotation for a Neutrino Factory and Muon Collider, DAVID NEUFFER, CARY YOSHIKAWA, Fermilab — We have developed scenarios for capture, bunching and phase-energy rotation of muons from a proton source, using high-frequency rf systems. The method captures a maximal number of muons into a string of rf bunches with initial application in the neutrino factory design studies. For a muon collider, these bunches must be recombined for maximal luminosity, and our initial design produced a relatively long bunch train. In this paper we present more compact scenarios that obtain a smaller number of bunches, and, after some optimization, obtain cases that are better for both neutrino-factory and collider scenarios. We also consider further modification by incorporating hydrogen gas-filled rf cavities for bunching and cooling. We describe these examples and consider variations toward an optimal factory + collider scenario.

Research supported by Department of Energy under contract no. DE-AC02-07CH11359and DOE STTR Grant DE-FG02-05ER-86252.

8:54AM H11.00003 Plasma Lens for Muon and Neutrino Beams, STEPHEN KAHN, SERGEY KORENEV, Muons Inc, MARY BISHAI, MILIND DIWAN, JUAN GALLARDO, ADY HERSHCOVITCH, BRANT JOHNSON, Brookhaven National Laboratory — The plasma lens is examined as an alternate to focusing horns and solenoids for use in a neutrino or muon beam facility. The plasma lens concept is based on a combined high-current lens/target configuration. The current is fed at electrodes located upstream and downstream from the target where pion capturing is needed. The current flows primarily in the plasma, which has a lower resistivity than the target. A second plasma lens section, with an additional current feed, follows the target to provide shaping of the plasma stability. The geometry of the plasma is shaped to provide optimal pion capture. Simulations of this plasma lens system have shown a 25% higher neutrino production than the horn system. A plasma lens has additional advantage: larger axial current than horns, minimal neutrino contamination during antineutrino running, and negligible pion absorption or scattering. Results from particle simulations using a plasma lens will be presented.

Supported by DOE contract DE-AC02-98CH18-886 and by STTR Grant DE-FG02-

9:06AM H11.00004 A New Concept of Liquid Lithium Lens for Muon Cooling, KEVIN LEE, DAVID CLINE, ALPER GARREN, YASUO FUKUI, UCLA — A new concept of liquid lithium lens is presented. The interest in the liquid lithium lens has been its potentially strong focusing for beam cooling, higher repetition rate than a few cycles per second and longer lifetime than solid lithium lens. Prototype liquid lithium lens for the Fermilab antiproton source was built and tested at BINF in Russia by G. Silvestrov and colleagues in the 1990s with some success, which circulated the liquid hot lithium using a liquid-metal pump. We present here a detailed conceptual design of the liquid lithium lens using push-pull action on the liquid lithium for circulation. The design and construction appears to be simple. We discuss the muon beam cooling possibility with this Li lens system.

We are grateful for the support from the DOE and for the discussions by J.P. Morgan and Tony Leveling at the Fermilab.
mass limits of 650 GeV at LHeC, 450 GeV at ILC and 600 GeV at LHC with optimal choices of relevant parameters.
e
show that the earlier measured properties of these particles may serve as a certain confirmation of the availability of mass structure of their interaction with fermions of a definite flavor. Findings open the possibility for establishing the laboratory limits of weak masses of all Dirac types of neutrinos. Thereby, they equations which relate the mass and its self components to charge, charge radius and magnetic moment of each neutrino as a consequence of unification of
Such connections explain the formation of paraneutrinos, for example, at the polarized neutrino electroweak scattering by spinless nuclei. We derive the structural
SULKHOZHA SHARAFIDDINOV, Institute of Nuclear Physics, Uzbekistan Academy of Sciences, Tashkent, 702132 Ulugbek, Uzbekistan — The mass of
for neutrino beams to be used in colliding beam configurations.
or planned neutrino experiments utilize neutrino beams and long-baseline detectors to explore flavor mixing but do not address the question of the origin of
oscillation experiments tell us that neutrinos have mass. However, they don’t tell us what mechanism is responsible for producing this neutrino mass. Current
processes using stopping muon beams provides access to new physics that cannot be addressed at energy frontier machines. The flux of muons into a small
typically emerge with momenta in the range of hundreds of MeV/c. The production rates, momentum spectra, spatial and angular distributions of muons emerging from various beam dump configurations have been studied using G4Beamline, a Geant4-based simulation program. In addition, calculated rates of surviving pions, protons, and neutrons will be presented. These results are intended to be useful for planning experiments that require a source of low energy muons, such as the MANX muon cooling experiment. The proton energies, 8 GeV and 120 GeV, correspond to those available at the Fermilab Booster and Main Injector, respectively.

We acknowledge the support from the DOE.

We support by DOE STTR grant DE-FG02-05ER86252.

The study of rare processes using stopping muon beams provides access to new physics that cannot be addressed at energy frontier machines. The flux of muons into a small

The study of rare processes using stopping muon beams provides access to new physics that cannot be addressed at energy frontier machines. The flux of muons into a small

The flux of muons into a small stoppage target is limited by the kinematics of the production process and by stochastic processes in the material used to slow the particles. Innovative muon beam cooling techniques are being applied to the design of stopping muon beams in order to increase the event rates in such experiments. Such intense stopping beams will also aid the development of applications such as muon spin resonance and muon-catalyzed fusion.

Supported in part by DOE SBIR/STTR grant DE-FG02-07ER84824

10:06AM H11.00009 Colliding neutrino beams , REINHARD SCHWIEHORST, Michigan State University — Neutrino oscillation experiments tell us that neutrinos have mass. However, they don’t tell us what mechanism is responsible for producing this neutrino mass. Current or planned neutrino experiments utilize neutrino beams and long-baseline detectors to explore flavor mixing but do not address the question of the origin of neutrino mass. In order to answer that question, neutrino interactions at much higher center-of-mass energies are required. I will describe several possibilities for neutrino beams to be used in colliding beam configurations.

Sunday, April 13, 2008 8:30AM - 9:54AM — Session H12 DPF: New Ideas Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis C

8:30AM H12.00001 Vector Currents of Massive Neutrinos of an Electroweak Nature , RASULKHOZHA SHARAFIDDINOV, Institute of Nuclear Physics, Uzbekistan Academy of Sciences, Tashkent, 702132 Ulugbek, Uzbekistan — The mass of an electroweakly interacting neutrino consists of the electric and weak parts responsible for the existence in it of charge, charge radius and magnetic moment. Such connections explain the formation of paraneutrinos, for example, at the polarized neutrino electroweak scattering by spinless nuclei. We derive the structural equations which relate the mass and its self components to charge, charge radius and magnetic moment of each neutrino as a consequence of unification of fermions of a definite flavor. Findings open the possibility for establishing the laboratory limits of weak masses of all Dirac types of neutrinos. Thereby, they show that the earlier measured properties of these particles may serve as a certain confirmation of the availability of mass structure of their interaction with field of emission.

8:42AM H12.00002 Heavy Lepton Production with Anomalous Interactions , AHMET TOLGA TASCI, AHMET TURAN ALAN, Abant Izzet Baysal University — We consider possible production of heavy leptons via anomalous interactions at future ep colliders (THERA and LHeC), e^+e^- colliders (ILC and CLIC) and pp collider CERN LHC. From the signal and background analysis of heavy leptons we obtained upper mass limits of 650 GeV at LHeC, 450 GeV at ILC and 600 GeV at LHC with optimal choices of relevant parameters.

This work was supported by AIBU Research Fund under grant no 2005.03.02.216.
phenomena in particle physics. Our results are summarized below:

1) Model. Building on our recent contributions Goldfain, OptiSolve Consulting — The origin of CP violation in K-meson channels and the strong CP problem are long-standing puzzles of the Standard any reference to the hypothetical Higgs scalar; b) the U systems of differential equations, we find that: a) particles acquire mass as plane wave solutions of the complex Landau-Ginzburg equation (CLGE), without suggesting that the theory of nonlinear dynamical systems offers a fresh approach to this challenge. Working from the universal route to chaos in coupled In general, solving these equations in closed form or through lattice-based computations has been accomplished with modest or limited success. Our study ERVIN GOLDFAIN, Welch Allyn Inc. — Quantum field theories, regardless of their formal content, lead to a large number of coupled nonlinear field equations. into both the near-side and away-side modifications. This talk will review medium responses to jet probes studied with 2-particle and 3-particle correlations. be explained by partons bent in chromo-magnetic fields, couplings with longitudinal flow, or other mechanisms. The away-side shows a broadened and even medium. This can be explored via particle correlations. Two-particle correlations with high... Due/FIAS/IKP Frankfurt — Interactions of jets with the medium produced in heavy-ion collisions can provide important insight into the properties of the Wien's displacement law

\[ \lambda = \frac{c}{v} = \frac{b}{T} \]

should provide a definitive test of the validity of these laws.

9:06AM H12.00004 Bifurcations and pattern formation in particle physics: a model study , ERVIN GOLDFAIN, Welch Allyn Inc. — Quantum field theories, regardless of their formal content, lead to a large number of coupled nonlinear field equations. Fractional dynamics as source of CP violation in the Standard Model, ERVIN GOLDFAIN, OptiSolve Consulting — The origin of CP violation in K-meson channels and the strong CP problem are long-standing puzzles of the Standard Model. Building on our recent contributions we find that breaking of CP symmetry is a direct manifestation of fractional dynamics and non-equilibrium phenomena in particle physics. Our results are summarized below:

9:18AM H12.00005 Fractional dynamics as source of CP violation in the Standard Model, ERVIN GOLDFAIN, OptiSolve Consulting — The origin of CP violation in K-meson channels and the strong CP problem are long-standing puzzles of the Standard Model. Building on our recent contributions we find that breaking of CP symmetry is a direct manifestation of fractional dynamics and non-equilibrium phenomena in particle physics. Our results are summarized below:

\[ |\epsilon_K|_{\text{EXP}} = (2.280 \pm 0.013) \times 10^{-3}, \quad |\epsilon_K|_{\text{THEOR}} = 2.162 \times 10^{-3} \]

\[ |\epsilon_K'|_{\text{EXP}} = (3.878 \pm 0.16) \times 10^{-6}, \quad |\epsilon_K'|_{\text{THEOR}} = 4.670 \times 10^{-6} \]

Here, \(|\epsilon_K|, |\epsilon_K'|\) are the two CP parameters describing the K-meson sector and \(\theta_{QCD}\) the CP term associated with the vacuum structure of Quantum Chromodynamics. 1) E. Goldfain, Communications in Nonlinear Science and Numerical Simulation, Volume 13, Issue 3, June 2008, Pages 666-676 2) E. Goldfain, Communications in Nonlinear Science and Numerical Simulation, Volume 13, Issue 7, September 2008, Pages 1397-1404

9:30AM H12.00006 The embodiment of the e-Science for High Energy Physics , HYUNWOO KIM, KIHYEON CHO, KISTI — The e-Science for High Energy Physics is to study High Energy Physics (HEP) any time and anywhere even if we are not on-site of accelerator laboratories. The contents are 1) data production, 2) data processing and 3) data publication any time and anywhere. The data production is to do remote control and take shifts remotely. The data processing is to run jobs anytime, anywhere using Grid farms. The data publication is to work together to publish papers using collaborative environment such as EVO (Enabling Virtual Organization) system. We apply this concept to high energy physics experiments using LCG farm at KISTI (Korea Institute of Science and Technology Information) and show the results.

3 Corresponding Author

9:42AM H12.00007 Nature of Reality , SUNIL THAKUR, Ind. Research — In this paper, I have examined entire spectrum of the issues concerning reality. We need to make two fundamental changes in our understanding of how nature manages universe. We must give up the idea that FTL communication is not possible. Second major change is that an object remains unmanifested till it finds a medium through which it can manifest itself. How the reality is revealed does not depend only on the properties of the reality itself but also depends on the properties of the medium through which the object is manifested. Light and heat are manifested information and therefore cannot carry information. Nothing exists that has illumination as its inherent property; photon is energy particle (not light particle). Matter is manifested energy; matter does not distort space, matter is distorted space. Light and heat remain unmanifested till energy finds mattter to manifest itself. Light does not travel; each particle illuminates as it receives energy from previous particle and acts as a ‘light bulb’ and hence illusion of forward motion. All communication in the universe takes place through radiation and radiation emitted by the object is directly proportionate to the energy incident upon it. Two experiments provide experimental evidence to this theory.

Sunday, April 13, 2008 8:30AM - 10:18AM — Session H13 DNP: Minisymposium on Correlations and Jets in Heavy-Ion Collisions Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis F

8:30AM H13.00001 Correlations and Jets in Heavy-Ion Collisions , JASON GLYNDDR ULERY, Purdue/IAS/IKP Frankfurt — Interactions of jets with the medium produced in heavy-ion collisions can provide important insight into the properties of the medium. This can be explored via particle correlations. Two-particle correlations with high p_T triggers have shown modified structures on both the near-side and away-side. The near-side shows a “ridge”, a structure that is correlated in azimuth but exhibits a long range structure in pseudo-rapidity. The ridge can be explained by partons bent in chromo-magnetic fields, couplings with longitudinal flow, or other mechanisms. The away-side shows a broadened and even double peaked structure in azimuth. Conical emission from Mach-cone shock waves or Cronkow gluon radiation along with other physics mechanisms have been suggested to explain this modification. Three-particle correlations and correlations with identified particles have been employed to provide further insight into both the near-side and away-side modifications. This talk will review medium responses to jet probes studied with 2-particle and 3-particle correlations.
Decomposition of awayside components of dijet correlation in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV at PHENIX, CHIN-HAO CHEN, Department of Physics and Astronomy, Stony Brook University, PHENIX COLLABORATION — At intermediate transverse momentum, dijet angular correlations show a local minimum at $\Delta \phi$, peaking one radian away from $\pi$. This structure indicates that the awayside jet is modified by the medium created in heavy ion collisions. We present the measurement of inclusive photon-hadron $\Delta \eta - \Delta \phi$ correlations from $\sqrt{s_{NN}} = 200$ GeV Au+Au collisions in PHENIX. In central collisions, an enhancement in per trigger associated hadrons in the near-side (trigger) jet is observed for $0 < \Delta \eta < 0.7$. The awayside components, as a function of $\Delta \eta$, are decomposed using $\phi$ into a head region, corresponding to the “punch through” jet, and a shoulder region containing the medium response. The awayside components are found to be independent of $\Delta \eta$. $p_T$ weighted yields allow investigation of how the transverse momentum is distributed between near- and away-side associated particles.

Jet study in doubly triggered $h^+\pm-h^\mp\pm$ correlations in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV, ERIC VAZQUEZ, Columbia University, PHENIX COLLABORATION — A hot dense medium exceeding the critical energy density for the formation of a partonic state of matter is created in Au+Au collisions at RHIC. This dense matter is extremely opaque to high energy partons and therefore leads to strong modifications of di-jets traversing the medium. These modifications are typically studied by comparing the di-hadron azimuthal correlation functions in Au+Au collisions to those in p+p collisions. However, a surface bias occurs in events triggered on a single hadron due to the larger probability of a high-$p_T$ parton emerging with little or no energy loss from production points near the surface of the medium. This effect can be mimicked, and in fact controlled, by studying events in which the production of two high-$p_T$ hadrons at large azimuthal separation is required. We present preliminary results of such an analysis performed in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV.

Baryon to Meson Ratios of Associated Hadrons in Di-Hadron Correlation, MARIA CRISTINA SUAREZ, University of Illinois at Chicago, STAR COLLABORATION — We present results on baryon and meson ($\bar{p}$, $p$ and $\pi^\pm$) spectra and ratios of associated hadrons in the di-hadron correlations with a high-$p_T$ hadron trigger. We will discuss the differences between the inclusive (non-triggered) ratios and the observed ratios in “jet” and “ridge” parts of 2-dimensional di-hadron $\Delta \phi - \Delta \eta$ correlations from 200 GeV central Au+Au collisions. We will discuss these results in conjunction with our measurements from d+Au collisions, also we will compare the ratios to those from inclusive $pp$ and $e^+e^-$ data and various models.

Direct measurement of fragmentation photons in p+p collisions at $\sqrt{s} = 200$ GeV with the PHENIX experiment, ALI HANKS, Columbia U, PHENIX COLLABORATION — In heavy ion collisions direct photons are an important observable because they are penetrating, and therefore remain largely insensitive to the final state effects that lead to jet quenching. Perturbative QCD calculations predict a contribution to the direct photon yield of up to 30% from photons produced through fragmentation. In heavy ion collisions it is expected that this contribution is modified due to additional stimulated photon bremsstrahlung as well as energy loss of the partons through gluon radiation prior to fragmentation. A measure of such photons would provide direct observation of the energy loss of jets in the medium. Thus measurements of the fragmentation component to direct photon yields in both $p+p$ and Au+Au collisions provides an important test of pQCD predictions and of the nuclear modification factor. Photons produced through jet fragmentation can be measured by selecting photons associated with jets using hadron-photon correlations, providing a natural way of extracting properties of the jet. However, this signal is small compared to the contributions to the inclusive yield from photons produced through $\alpha^0$, $\eta$, and other mesonic decays, requiring a precise determination of these backgrounds. We present results from the application of this approach to PHENIX $p+p$ data and discuss its potential for signal extraction in heavy ion collisions.

Photon-hadron Correlations Measured in Au-Au Collisions at $\sqrt{s_{NN}} = 200$ GeV with the PHENIX Detector, MEGAN CONNORS, Stony Brook University, PHENIX COLLABORATION — Two particle correlations are used to understand the tomography of heavy ion collisions at RHIC. In particular, photon-hadron correlations are an excellent probe of medium effects. Using the photon momentum to tag the momentum of the opposing jet, we can study jet energy loss and measure the modified fragmentation function. This talk will present the photon-hadron correlations in Au-Au collisions measured from data collected during Run7 by the PHENIX experiment. To make this correlation, we employ an established statistical procedure to extract the direct photon yield which subtracts the background from decay photons from our inclusive measurement. Previous measurements are improved by the increase in statistics achieved in Run 7.

Measurement of High $p_T$ Flow and Jet Correlation in Au+Au Measurement of High $p_T$ Flow and Jet Correlation in Au+Au Collisions at $\sqrt{s_{NN}} = 200$ GeV from PHENIX, RUI WEI, PHENIX, PHENIX COLLABORATION — Single hadron yields at high transverse momentum $p_T$ are observed to be strongly suppressed in central Au+Au collisions. This suppression is thought to be the result of jet quenching, and the observed high $p_T$ hadrons are thought to be dominated by fragmentation of hard scattered partons emitted from the surface of the overlap region. Although extremely simplistic, this picture would lead to a small but finite $v_2$ and a relatively unmodified near-side jet shape for these high $p_T$ hadrons. A combined study of the $v_2$ and near-side jet correlations of leading hadrons can improve our understanding of the particle production mechanism and geometrical bias in this $p_T$ region. PHENIX experiment installed a new reaction-plane detector and collected 5.5 billion Au+Au events in Run7. The significantly improved ability to determine the reaction-plane and large statistics allow a more detailed study of flow and jet correlation. Results on the elliptic flow and jet correlation for high $p_T$ hadrons are presented.

8:30AM H14.00001 Decay of $^{10}$C excited states above the $2p + 2\alpha$ threshold and the contribution from “democratic” two-proton emission, K.M. MERCURIO, R.J. CHARITY, R. SHANE, L.G. SOBOTKA, J. ELSON, Washington University in St. Louis, M. FAMIANO, A. WUOSMAA, Western Michigan University, A. BANU, C. FU, L. TRACHE, R.E. TRIBBLE, Texas A&M University Cyclotron Institute — The decay of $^{10}$C excited states to the $2p + 2\alpha$ exit channel has been studied using an $E/A = 10.7$ MeV $^{10}$C beam inelastically scattered from a $^9$Be target. Levels associated with the two-proton decay to the ground state of $^9$Be have been observed. These include states at 5.18 and 6.54 MeV which decay by sequential two-proton emission through the long-lived intermediate state of $^9$B. In addition, these two states have branches, or there exist other states at almost the same energies, for which there is no long-lived intermediate state between the two proton emissions. For the 6.57 MeV state, the two protons are preferably emitted on the same side of the $^{10}$C fragment. Evidence is found for a state at $E^* = 8.4$ MeV in $^{10}$C which decays through the 2.35 MeV second excited state of $^9$B. A large data set of kinematically complete $^6$Be$\rightarrow$2p + $\alpha$ events was also collected.
8:42AM H14.00002 Precision measurements of electromagnetic matrix elements as a test of Ab-Initio calculations in light nuclei . E. A. MCCUTCHEON, C. J. LISTER, M. P. CARPENTER, R. V. F. JANSSENS, T. L. KHOO, T. LAURITSEN, E. F. MOORE, D. SEWERYNIK, S. ZHU, Physics Division, Argonne National Laboratory, Argonne, Ill. 60439 — Recent ab-initio shell model calculations of light nuclei have underlined the importance of 3-body forces. Gamma-ray spectroscopy of certain excited states in light nuclei can test new formulations of the interaction, as both the diagonal and off diagonal matrix elements are sensitive to it. A particularly interesting set of cases lie in the A = 10 systems, 10Be, 10B, and 10C, where the inclusion of 3-body forces is found to invert the sequence of states. This has been attributed to the important contribution of the 3-body interactions to the overall spin-orbit force. Precise (<10%) matrix elements are needed to challenge the latest calculations, requiring a new generation of improved experiments. Lifetimes of excitations in A = 10 nuclei, populated in the 24Li(24Li, xpn) reaction, will be determined using high velocity DSAM lineshape measurements. Preliminary results of the experiment will be presented and discussed in terms of recent ab-initio shell model calculations. This research was supported by the DOE Office of Nuclear Physics under contract DE-AC02-06CH11357.

8:54AM H14.00003 Measurement of the ground state of 15Be . A. SPYROU, T. BAUMANN, D. BAZIN, G. CHRISTIAN, S. MOSBY, M. STRONGMAN, M. THOENNESSEN, NSCL/MSU, J. BROWN, Washab College, P. A. DEYOUING, Hope College, A. DELINE, J. E. FINCK, A. RUSSELL, Central Michigan University, N. FRANK, Illinois Wesleyan University, E. BREITBACH, R. HOWES, Marquette University, W. A. PETERS, Rutgers, A. SCHILLER, Ohio University, MONA COLLABORATION — The ground state of the neutron-unbound 15Be was measured for the first time. The experiment was performed at the National Superconducting Cyclotron Laboratory using the MoNa-Sweeper setup. The isotope of interest was produced via two-proton knockout from a 17C beam at 54 MeV/nucleon. The n-14Be decay spectrum was reconstructed event-by-event from coincidence measurements of the 1Be fragment and the emitted neutron. The energy and position of the neutron were obtained using the Modular Neutron Array (MoNA), while for determining the same information for the 1Be fragment, a series of position and energy sensitive detectors, located at the Sweeper magnet focal plane, were used. First results from the analysis of this measurement will be presented. The present work aimed in determining the mass of the neutron-unbound 15Be and it was the first step towards the study of a possible di-neutron decay of 16Be.

9:06AM H14.00004 Isotope ratios measured in symmetric and asymmetric 40,48Ca+10,18Ca collisions . D. HENZLOVA, NSCL MSU, D. BROWN**, B. CHARITY*, A. CHERBIHI*, D. COUPLAND*, R. DE SOUZA*, J. ELSON*, M. FAMIANO*, V. HENZL*, S. HUDDAY*, M. KILBURN*, J. LEE*, S. LUKYANOV*, B. LYNG*, A. ROGERS*, A. SANETULLAEV*, L. SOBOTKA*, Z. SUN*, B. TSANG*, G. VERDE*, M. WALLACE*, M. YOUNGS*, G. WESTFALL**, A. VANDER MOLEN**, HIRA COLLABORATION, **4PI COLLABORATION — In a recent experiment performed at NSCL three reaction systems with very different isospin contents were investigated at incident energy of 80A MeV – 40Ca, 48Ca+10Ca and 48Ca+40Ca. The reactions were studied in a 4pi geometry using an MSU 4pi detector (array of 224 phoswich scintillators) in combination with HIRA (High Resolution Array), a high granularity Si strip/Cd detector array. The former was used to determine the centrality of the collision, while the latter gave precise energy and angular information of the emitted light fragments. The measured reactions span a wide range of system isospin (N/Z=1 to 1.4) and thus serve as an important source of information on the influence of isospin of the reaction system on some of the basic properties of the dense and highly excited system formed in these collisions. Preliminary results on isotope ratios and isoscaling will be presented. This work is supported by the National Science Foundation under Grant Nos. PHY-0606007 and PHY-9977707.

9:18AM H14.00005 NP pairing in N=Z nuclei : The 44Ti(He,p) reaction . A. O. MACCHIARELLI, P. FALLON, R. M. CLARK, M. CROMAZ, I. Y. LEE, M. WIEDEKING, Lawrence Berkeley National Laboratory, K. E. REHIM, I. AHMAD, J. GREENE, R. V. F. JANSSENS, M. NOTANI, R. PARDO, J. P. SCHIFFER, D. SEWERYNIK, X. D. TANG, Argonne National Laboratory, A. WUOSMAA, Western Michigan University — Neutron-proton pairing in N=Z nuclei is a subject of current interest in nuclear physics. Data from two-neutron transfer reactions using Ca and Ni isotopes are consistent with a picture of isovector pairing vibrations. However, it is still an open question whether the isoscalar component generates collective modes. The 4He reaction stands out as an ideal tool to study np correlations and we started a program to study it in inverse kinematics using radioactive beams at the Argonne ATLAS facility. 44Ti (60y half-life) provides an excellent case that allows for a practical chemical separation and for better conditions to optimize the accelerator parameters. A pellet containing 100uci of 44Ti was used in the Tandem ion source to deliver a 5 MeV/A 44Ti beam onto a 3He gas cell (~100µg/cm2 thickness) placed in a scattering chamber in front of the FMA. A beam intensity of 106/s was achieved during the four day run. Protons were detected in two Si ring detectors in coincidence with 40He recoils detected by the FMA. Details of the experiment and preliminary results will be discussed. - Supported by U.S. DOE under contracts DE-AC02-05CH11231 (LBNL) and DE-AC02-06CH11357 (ANL).

9:30AM H14.00006 Attempts to Manipulate the Decay Time of Radioactive Nuclei . B. FALLIN, B. GRABOW, W. TORNOW, Duke University / TUNL. — It has been known for 20 years that electron screening strongly changes nuclear reaction cross sections at sub-Coulomb charged-particle projectile energies. The screening energy can be increased considerably if the target atoms are implanted in a metallic host and cooled to low temperature (T<10 K). The large screening in metals derives from the Debye plasma model applied to the quasi-free metallic electrons. If “time reversed,” this model implies that the lifetime of radioactive nuclei placed in a metallic host can be manipulated by orders of magnitude. For α and β decay one expects a shorter half-life, while for β− decay and EC, a longer half-life is expected. The results of prior experiments testing this theory are controversial; about half of the published data confirm an effect, while the other half observ no effect. We will report on our experimental studies using 64Cu and 68Zn nuclei produced at TUNL via the 64Cu(p,p) and 68Cu(p,n) reactions, respectively. For 64Cu, we detected the 511 keV annihilation γ rays and for 68Zn the 1115.5 keV γ rays using HPGe detectors. In both cases we did not observe a half-life change outside experimental uncertainties between measurements at room temperature and those with the samples cooled to T=12 K.

8:42AM H14.00007 The Role of Triaxiality in Shape-Coexistence in Light Krypton Isotopes . S. FISCHER, Physics Department DePaul University and Argonne National Laboratory, C.J. (KIM) LISTER, Physics Division Argonne National Laboratory — Shape co-existence in lead and krypton nuclei has become a cutting-edge topic in understanding the structure of heavier nuclei. Prediction of the relative binding energies of different shapes, understanding the mixing between configurations, and a discriminating challenge to nuclear theory. The occurrence of two well bound shapes has been demonstrated through the observation of low-lying Jπ=0+ isomers and through radioactive beam Coulomb excitation. Roughly speaking, the shapes correspond to oblate-like and prolate-like configurations. However, the exact shapes, and the role of triaxiality has yet to be fully explored. We present new results from “in-beam” heavy-ion spectroscopy on 74Kr which shows that the population of the isomer is mainly through a gamma-coupled vibrational band and that considerable mixing is involved between the states built on the isomer and the gamma band. This research was supported by the DOE Office of Nuclear Physics under contract DE-AC02-06CH11357.

1Supported in part by DOE, Office of NP, grant #DE-FG02-07ER41033.
2REU student, Summer 2007, TUNL, NSF grant #PHY-0552732
9:54AM H14.00008 Level densities of residual nuclei from the reactions $^6\text{Li}$ on $^{58}\text{Fe}$ and $^7\text{Li}$ on $^{57}\text{Fe}$, B. BABATUNDE OGUNNI, STEVEN GRIMES, ALEXANDER VOINOV, ADEREMI ADEKOLA, Ohio University, CARL BRUNE, Ohio University, ZACHARY HEINEN, MICHAEL HORNSH, THOMAS MASSEY, Ohio University, CATALIN MATEI, Oak Ridge National Laboratory, DON CARTER, JOHN O’DONNELL, Ohio University — The reactions $^6\text{Li}$ on $^{58}\text{Fe}$ and $^7\text{Li}$ on $^{57}\text{Fe}$ have been studied; these two reactions give the same compound nucleus, $^{64}\text{Cu}$. The neutron, proton and alpha spectra were measured at backward angles, and the level densities of the residual nuclei from the particle evaporation spectra have been obtained. The contribution of the breakup mechanism to the reaction cross-section was studied from $^6\text{Li}$ on $^{197}\text{Au}$ reaction. The data obtained have been compared with Hauser Feshbach model calculations performed with HF and Empire codes. Three other reactions were also studied to see how level densities change as we move away from the nuclear stability line. These are: $^{18}\text{O}$ on $^{64}\text{Ni}$ reaction, this gives $^{62}\text{Kr}$ as compound nucleus which is on the stability line; $^{23}\text{Mg}$ on $^{58}\text{Fe}$ this gives $^{82}\text{Sr}$ as compound nucleus and $^{24}\text{Mg}$ on $^{56}\text{Fe}$ which gives $^{82}\text{Zr}$ as compound nucleus; these are two and four steps away from the stability line respectively. Some results are presented.

1Support from DOE

Sunday, April 13, 2008 8:30AM - 10:06AM
Session H15 DNP: Nuclear Astrophysics II
Hyatt Regency St. Louis Riverfront (formerly Adam039:s Mark Hotel), St. Louis H

8:30AM H15.00001 The Astrophysical $^{187}\text{Re}/^{187}\text{Os}$ Ratio: Measurement of the $^{187}\text{Re}(n, 2n)$ $^{186}\text{Re}$ Destruction Cross Section1, J.H. KELLEY, NC State U and Triangle Universities Nuclear Laboratory, D.B. MASTERS, Samford U, S. HAMMOND, H.J. KARWOWSKI, UNC-Chapel Hill and TUNL, E. KWAN, A. HUTCHESON, A.P. TONCHEV, W. TORNOW, Duke U and TUNL, F.G. KONDEV, S. ZHU, Argonne National Laboratory — We have initiated a program to measure neutron-induced cross sections on $^{187}\text{Re}$ using monenergetic proton beams and an array of HPGe $\gamma$-ray detectors at TUNL. Our emphasis is on measuring transitions in the $^{187}\text{Re}(n, 2n)$ reaction that populate the long-lived isomeric state, $^{186m}\text{Re}$. These data are needed to decrease uncertainties in the $^{187}\text{Re}/^{187}\text{Os}$ cosmochronometer, which dates the r-process nucleosynthesis. Results from a first run using a pulsed 12 MeV neutron beam will be presented, and an overview of planned measurements that will measure the excitation function making use of both prompt $\gamma$-ray detection and activation techniques will be given.

1Partly supported by the U.S. Dept. of Energy DE-FG02-97ER41033, DE-FG02-97ER41042, DE-FG02-97ER41041, DE-AC02-06CH11357 and NSF-05-52273

8:42AM H15.00002 A Study of the $^{14}\text{C}(?,?)$ Reaction Rate Through the ANC Technique. E.D. JOHNSON, G.V. ROGACHEV, Florida State University, A.M. MUKHAMEDZHANOEV, Texas A&M University, A. AGUILAR, P. BENDER, T. DEVORE, Florida State University, G.V. GOLDBERG, Texas A&M University, K.W. KEMPNER, S. LEE, L. MILLER, J. MITCHELL, P. PEPLOWSKI, M. PERRY, R. REYNOLDS, A. ROJAS, Florida State University — The astrophysical significance of the $^{14}\text{C}(?,?)$ reaction is due to its involvement in the NCO chain. The NCO chain is thought to trigger He flashes in white dwarf stars, and is also thought to be a neutron source for the s-process in low mass stars [L. Buchmann et al., The Astrophys. Journ. 324 (1988), M. Hashimoto et al., The Astrophys. Journ. 307 (1986)]. Recently the ANC of the $^{3}\text{He}$ nucleus was measured in the S800 spectrograph. Details of the experimental setup will be presented, and an overview of the current stage of the analysis will be presented.

8:54AM H15.00003 Effects on $^{18}\text{F}$ production in novae from changes in the $^{17}\text{O}(p,\alpha)^{14}\text{N}$ rate , B.H. MOAZEN, Univ. of Tenn, J.C. BLACKMON, D.W. BARDAYAN, ORNL, K.Y. CHAE, Univ. of Tenn., K. CHIPP, CO School of Mines, C.P. DOMIZIOLI, Tenn. Tech. Univ., R. FITZGERALD, UNC, U. GREIFE, CO School of Mines, W.R. HIX, ORNL, K.L. JONES, Univ. of Tenn., R.L. KOZUB, Tenn. Tech. Univ., E.J. LINGERFELT, Univ. of Tenn., R.J. LIVESAY, CO School of Mines, C.D. NESARAJA, ORNL, S.D. PAIN, Rutgers, L.F. ROBERTS, ORNL, UCSC, J.F. SHRINGER JR., Tenn. Tech Univ., M.S. SMITH, ORNL, J.S. THOMAS, Rutgers — The properties of a resonance at 183 keV are important for understanding the $^{17}\text{O}(p,\alpha)^{14}\text{N}$ and $^{17}\text{O}(p,f)^{18}\text{F}$ reaction rates at nova temperatures and was recently reported to significantly increase the $(p,\alpha)$ reaction rate. A method involving the bombardment of a hydrogen filled target chamber was recently developed at ORNL for measuring the strength and energy of $(p,\alpha)$ resonances and was applied to measure this resonance in $^{17}\text{O}(p,\alpha)^{14}\text{N}$. The strength of the resonance was confirmed and post-processing nova nucleosynthesis simulations show the new $^{17}\text{O}(p,\alpha)^{14}\text{N}$ reaction rate significantly decreases $^{18}\text{F}$ production in low mass ONeMg novae but has little effect on more energetic novae [Moazen et. al. Phys. Rev. C 75 065801 (2007)]. Results and astrophysical implications will be presented as well as future plans to measure $^{18}\text{F}(p,\alpha)^{15}\text{O}$ with this technique.

9:06AM H15.00004 Spin assignments of $^{22}\text{Mg}$ through a $^{24}\text{Mg}(p,t)^{22}\text{Mg}$ measurement, K.Y. CHAE, U. of TN, B.W. BARDAYAN, J.C. BLACKMON, ORNL, B.H. MOAZEN, U. of TN, K. CHIPP, CO School of Mines, R. HATARIK, Rutgers, K.L. JONES, U. of TN, R.L. KOZUB, T.TU, J.F. LIANG, ORNL, C.D. NESARAJA, U of TN, P.D. O’MALLEY, Rutgers, C. MATEI, ORAU, S.D. PAIN, Rutgers, S.T. PITTMAN, U. of TN, M.S. SMITH, ORNL — The $^{24}\text{Mg}(p,\alpha)^{22}\text{Mg}$ reaction plays a crucial role in the $(\alpha,p)$ process, which leads to the rapid proton capture process in X-ray bursts. The reaction rate depends upon properties of $^{25}\text{Mg}$ levels above the alpha threshold at 8.14 MeV. Despite recent studies of these levels, only the excitation energies are known for most with no constraints on the spins. We have studied the $^{24}\text{Mg}(p,t)^{22}\text{Mg}$ reaction at the ORNL Huifield Radioactive Ion Beam Facility, and by measuring the angular distributions of outgoing tritons, hope to provide the first experimental constraints on the spins of astrophysically-important $^{18}\text{Ne}(\alpha,p)^{20}\text{Na}$ resonances. Details of the experiment and a report of the current stage of the analysis will be presented.

* This work was supported in part by the US DOE and the NSF.

9:18AM H15.00005 Experimental Exploration of $^{60}\text{Br}$ and the rp-Process $^{68}\text{Se}$ Waiting Point, A.M. ROGERS, NSCL MSU, M.A. FAMIANO, M.S. WALLACE, M.-J. VAN GOETHEM, F. DELAUNAY, W.G. LYNCH, M.B. TSANG, M. MOCKO, J. LEE, R.T. DE SOUZA, S. HUDAN, L.G. SOBOTTKA, R.J. CHARITY, J. ELSON, S. LOBASTOV, D. SHAPIRA, D. BAZIN, A. GADE, G. VERDE, HIRA COLLABORATION — To realistically model the rp-process, experimental data along the proton dripline are required. Of particular interest is the $^{68}\text{Se}$ waiting point region where proton capture is inhibited. The reaction rate for the 2p-capture process $^{68}\text{Sr} + {2p} ightarrow ^{68}\text{Kr}$ depends exponentially on the Q-value, which is poorly constrained. We have performed an experiment to measure Q-values of proton unbound states of nuclei, specifically $^{60}\text{Br}$, at the NSCL Coupled Cyclotron Facility. The experiment is designed to reconstruct the decays of proton unbound nuclei such as $^{60}\text{Br}$ by detecting the decay protons using the MSU High Resolution Array (HiRA) in coincidence with a heavy residue, e.g., $^{68}\text{Sr}$, which is measured in the S800 spectograph. Details of the experimental setup as well as preliminary experimental results will be presented.

1This work is supported by the National Science Foundation under Grant Nos. PHY-0606007 and PHY-9977707.
ν scattering parameters in the 1 GeV energy region. MINOS is a two detector long-baseline neutrino experiment designed to study oscillation phenomena using zero-neutrino double beta decay (ββ0ν) offer hope for determining the absolute mass scale. In particular, zero-neutrino double beta decay (ββ0ν) scale for the neutrino is unknown. Furthermore, the critical question: Is the neutrino its own antiparticle? remains unanswered. Studies of double beta decay future (0νββ) will be discussed in the context of the future (0νββ).

The equation of state of bulk nuclear matter is one of the most important microscopic inputs in the understanding of supernovae explosions and cooling of proto-neutron stars. This talk will describe calculations of the equation of state of nuclear matter at finite temperature based on the variational principle and correlated basis functions, and using modern realistic two-body (Argonne v18) and three-body (Urbana IX) nuclear forces. This work is a generalization of the Akmal-Pandharipande-Ravenhall equation of state to finite temperatures. The behavior of some other important physical quantities including the effective mass will also be discussed.

This work is supported by in part by US NSF via grant PHY 07-01611

Deceased

Sunday, April 13, 2008 10:45AM - 12:33PM –
Session J2 DNP DPF: Joint Session on Neutrinos

Hyatt Regency St. Louis Riverfront (formerly Adam’s Mark Hotel), St. Louis D

10:45AM J2.00001 Recent Progress in Neutrinoless Double Beta Decay: Its Forecast for the Future

STEVEN ELLIOTT, Los Alamos National Laboratory — At least one neutrino has a mass of about 50 meV or larger. However, the absolute mass scale for the neutrino is unknown. Furthermore, the critical question: Is the neutrino its own antiparticle? remains unanswered. Studies of double beta decay offer hope for determining the absolute mass scale. In particular, zero-neutrino double beta decay (ββ0ν) can address the issues of lepton number conservation, the particle-antiparticle nature of the neutrino, and its mass. Recent experimental results have demonstrated the increasing reach of the technologies used to search for (ββ0ν). In addition, theoretical progress in understanding the nuclear physics involved has also been impressive. All indications are that upcoming generations of (ββ0ν) experiments will be sensitive to neutrino masses in the exciting range below 50 meV. A summary of the recent results in (ββ0ν) will be discussed in the context of the future (ββ0ν) program.

11:21AM J2.00002 Sunshine: Photons or Neutrinos – which tells us more?1

R. VOGELAAR, Virginia Tech — Tremendous progress over the past decade puts us within striking distance of finally being able to accurately measure the luminosity of the Sun using neutrinos and only the most basic assumptions from the Standard Solar Model. Along the way we have learned a lot about neutrinos themselves, and they have proven to be very interesting indeed. While photons probe the Sun’s surface and can be used with helioseismology to probe quite deep, neutrinos tell us about the Sun’s interior. Do these match? Our most fundamental understanding of stellar evolution and neutrino oscillations are uniquely testable by this comparison. The recent results of Borexino, coupled with results from SNO and KamLAND and new solar metallicity studies are starting to bear fruit and point towards the next steps which could well lead to even more surprises.

1Support from NSF Nuclear Physics grant 0501118.

11:57AM J2.00003 Results from MiniBooNE and MINOS

RUSTEM OSPANOV, The University of Texas at Austin — Fermi National Accelerator Laboratory has an active neutrino program with MiniBooNE, MINOS and SciBooNE experiments presently taking data. All three experiments utilize high intensity accelerator-based neutrino beams. MiniBooNE has recently published a measurement of the νμ → ντ appearance rate which is consistent with no oscillations in the accessible region of ∆m2 and sin2(2θ) parameter space. MiniBooNE has also measured charged current νμ quasi-elastic scattering parameters in the 1 GeV energy region. MINOS is a two detector long-baseline neutrino experiment designed to study oscillation phenomena using νμ beam. MINOS has measured the νμ disappearance rate for the atmospheric mass splitting ∆m2 atm. MINOS also actively pursues analyzes of far detector events searching for νμ → ντ appearance and for disappearance of ντ into sterile neutrinos. This presentation will focus on latest results from the MiniBooNE and MINOS collaborations and provide an analysis update for future measurements.

Sunday, April 13, 2008 10:45AM - 12:33PM –
Session J3 FHP FPS: Los Alamos and the Manhattan Project: 65th Anniversary (Followed by Panel Discussion)

Hyatt Regency St. Louis Riverfront (formerly Adam’s Mark Hotel), St. Louis E
occurred on the general methodology of these techniques and the range of phenomena to which these schemes have been applied. These numerical integration techniques for differential equations had their genesis in a 1989 publication.

C. CASSIDY1, Hofstra University — Discussion among former participants in the Manhattan Project.

The research reported here was supported by a grant from DOE.

1 Wilfred R. and Ann Lee Konneker Distinguished Professor of Physics. Supported in part by the U.S. Department of Energy.

11:21AM J4.00002 Ghostbusting: Reviving quantum theories that were thought to be dead1, CARL BENDER, Washington University in St. Louis — The average quantum physicist on the street believes that a quantum-mechanical Hamiltonian must be Dirac Hermitian (symmetric under combined matrix transposition and complex conjugation) in order to be sure that the energy eigenvalues are real and that time evolution is unitary. However, the Hamiltonian $H = p^2 + ix^3$, for example, which is clearly not Dirac Hermitian, has a real positive discrete spectrum. Evidently, the axioms of Dirac Hermiticity are too restrictive. While the Hamiltonian $H = p^2 + ix^3$ is not Dirac Hermitian, it is PT symmetric; that is, it is symmetric under combined space reflection P and time reversal T. In general, if a Hamiltonian $H$ is not Dirac Hermitian but exhibits an unbroken PT symmetry, there is a procedure for determining the adjoint operation under which $H$ is Hermitian. (It is wrong to assume a priori that the adjoint operation that interchanges bra vectors and ket vectors in the Hilbert space of states is the Dirac adjoint. This would be like assuming a priori what the metric $g^{\mu\nu}$ in curved space is before solving Einstein’s equations.) In the past a number of interesting quantum theories, such as the Lee model and the Pais-Uhlenbeck model, were abandoned because they were thought to have an incurable disease. The symptom of the disease was the appearance of ghost states (states of negative norm). The cause of the disease is that the Hamiltonians for these models were inappropriately treated as if they were Dirac Hermitian. The disease can be cured because the Hamiltonians for these models are PT symmetric, and one can calculate exactly and in closed form the appropriate adjoint operation under which each Hamiltonian is Hermitian. When this is done, one can see immediately that there are no ghost states and that these models are fully acceptable quantum theories.

1 The research reported here was supported by a grant from DOE.

10:45AM J4.00001 A History Worth Preserving, CYNTHERIA KELLY — The Manhattan Project transformed the course of American and world history, science, politics and society. If we can read about this in books and watch History Channel documentaries, why do we need to preserve some of the properties of this enormous undertaking? The presentation, “A History Worth Preserving,” will address why some of the physical properties need to be preserved and which ones we are struggling to maintain for future generations. The story of this effort begins in 1997 as the Department of Energy was poised to demolish the last remaining Manhattan Project properties at the Los Alamos laboratory. Located deep behind security fences, the “V Site” asbestos-shingled wooden buildings looked like humble garages with over-sized wooden doors. The “V Site” properties were almost lost twice, first to bulldozers and then the Cerro Grande fire of 2000. Now, visitors can stand inside the building where J. Robert Oppenheimer and his crew once worked and imagine the Trinity “gadget” hanging from its hoist shortly before it ushered in the Atomic Age on July 16, 1945. As Richard Rhodes has commented, we preserve what we value of the physical past because it specifically embodies our social past. But many challenge whether the Manhattan Project properties ought to be preserved.

11:57AM J4.00003 Panel Discussion among Physicist Alumni of the Manhattan Project. — Discussion among former participants in the Manhattan Project.

1 Moderator

Sunday, April 13, 2008 10:45AM - 12:33PM – Session J4 DCOMP: Topics in Mathematical and Computational Physics

10:45AM J4.00001 Edward A. Bouchet Award Talk: NSFSD Schemes: Genesis, Methodology and Applications1, RONALD MICKENS, Clark Atlanta University — Nonstandard finite difference (NSFD) schemes are based on a generalization of the usual discrete representations of first derivatives and the use of nonlocal discrete replacements for both linear and nonlinear functions of dependent variables. These numerical integration techniques for differential equations had their genesis in a 1989 publication.1 In the past decade much progress has occurred on the general methodology of these techniques and the range of phenomena to which these schemes have been applied.2 This talk will give a broad introduction to NSFSD schemes and show that the principle of dynamic consistency (DC)3 can be used to place great restrictions on the constructions of such discretizations for both ODE’s and PDE’s. The essential features of the NSFSD methodology will be illustrated by means of several “toy” models.4


11:21AM J4.00002 Nicholas Metropolis Award for Outstanding Doctoral Thesis Work in Computational Physics Talk: Equation of State of the Dilute Fermi Gases, SOON YONG CHANG, INT-U. of Washington — In the recent years, dilute Fermi gases have played the center stage role in the many-body physics. The gas of neutral alkali atoms such as Lithium-6 and Potassium-40 can be trapped at temperatures below the Fermi degeneracy. The most relevant feature of these gases is that the interaction is tunable and strongly interacting superfluid can be artificially created. I will discuss the recent progress in understanding the ground state properties of the dilute Fermi gases at different interaction regimes. First, I will present the case of the spin symmetric systems where the Fermi gas can smoothly crossover from the BCS regime to the BEC regime. Then, I will discuss the case of the spin polarized systems, where different quantum phases can occur as a function of the polarization. In the laboratory, the trapped Fermi gas shows spatial dependence of the different quantum phases. This can be understood in the context of the local variation of the chemical potential. I will present the most accurate quantum ab initio results and the relevant experiments.
**Sunday, April 13, 2008 10:45AM - 12:33PM**

**Session J5 FEd DPB: The U.S. Particle Accelerator School** Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade C

**10:45AM J5.00001 Overview of USPAS and its role in educating the next generation of accelerator scientists and engineers**. WILLIAM BARLETTA, USPAS / Dept. of Physics, MIT / Fermi National Accelerator Laboratory — Accelerators are essential engines of discovery in fundamental physics, biology, and chemistry. Particle beam based instruments in medicine, industry and national security constitute a multi-billion dollar per year industry. More than 55,000 peer-reviewed papers having accelerator as a keyword are available on the Web. Yet only a handful of universities offer any formal training in accelerator science. Several reasons can be cited: 1) The science and technology of particle beams and other non-neutral plasmas cuts across traditional academic disciplines. 2) Electrical engineering departments have evolved toward micro- and nano-technology and computing science. 3) Nuclear engineering departments have atrophied at many major universities. 4) With few exceptions, interest at individual universities is not extensive enough to support a strong faculty line. The United States Particle Accelerator School (USPAS) is National Graduate Educational Program that has developed a highly successful educational paradigm that, over the past twenty-years, has granted more university credit in accelerator / beam science and technology than any university in the world. Governed and supported by a consortium of nine DOE laboratories and two NSF university laboratories, USPAS offers a responsive and balanced curriculum of science, engineering, computational and hands-on courses. Sessions are held twice annually, hosted by major US research universities that approve course credit, certify the USPAS faculty, and grant course credit. The USPAS paradigm is readily extensible to other rapidly developing, cross-disciplinary research areas such as high energy density physics.

**11:21AM J5.00002 USPAS from a student’s perspective: learning about accelerator physics.** , EVGENYA SMIRNOVA, Los Alamos National Laboratory — Overall, graduate education in the US is widely considered to be of the highest quality with the students from around the world entering our Universities. The difference between the US and European (in particularly, Russian) graduate educations is the availability of scholarly part in the US graduate programs. It consists of a number of classes (often mandatory) which help students to master their particular specialty and compensate for the lack of special classes during undergraduate years mostly overloaded with general studies. However, accelerator physics specialty somehow historically become an exclusion with very few Universities offering classes in accelerators. The USPAS has become an essential part of my graduate education in accelerator physics, compensated for the lack of coursework at MIT, and greatly expedited my progress in thesis research.

**11:57AM J5.00003 The USPAS from the perspective of the instructor**. , MICHAEL SYPHERS, Fermi National Accelerator Laboratory — The evolution of the U.S. Particle Accelerator School over the past two decades is examined from the perspective of one instructor with experience teaching graduate students, undergraduate students, accelerator professionals and other “interested parties,” throughout the history of the school’s university credit program.

1 Operated by Fermi Research Alliance, LLC under Contract No. DE-AC02-07CH11359 with the United States Department of Energy.

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**Sunday, April 13, 2008 10:45AM - 12:33PM**

**Session J6 DPP GPAP: Jets and Gamma Ray Bursts** Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade D

**10:45AM J6.00001 Magnetohydrodynamics of Gamma-Ray Burst Jets**. ARIEH KONIGL, University of Chicago — Magnetic fields are believed to play a dominant role in driving and collimating astrophysical jets, including the relativistic outflows that emanate from the vicinity of the supermassive black holes in active galactic nuclei and the ultrarelativistic jets, evidently associated with solar-mass black holes or rapidly rotating neutron stars, that are inferred to give rise to gamma-ray bursts (GRBs). Recent numerical simulations using special-relativistic, axisymmetric, ideal MHD have demonstrated the viability of this mechanism and revealed the detailed structure of relativistic plasma outflows of this type. The main results of these simulations are presented and analyzed, and their qualitative properties are explained with the help of steady-state, radially self-similar, semianalytic solutions and asymptotic analytic scalings. The distinctions between relativistic and nonrelativistic outflows and between MHD and purely hydrodynamic acceleration are highlighted, and the possible effect of initial thermal driving in GRB sources is discussed. Remaining open questions related to the general modeling of such outflows and to the specific application to GRB jets are pointed out.

**11:21AM J6.00002 Jets in Relativistic Cosmic Explosions**. SHRIRAM KULKARNI, California Institute of Technology — In this talk the speaker will first review relativistic cosmic explosions: gamma-ray bursts and radio sparks. GRBs are now recognized to be the most relativistic and highly collimated explosions. Radio sparks is an entirely new phenomenon (we have only one example as of November 2007). However, circumstantial evidence shows that this event is at extra-galactic distance. If so, these involve ultra-strong electromagnetic waves. The plasma physics of GRB jets and radio sparks is a frontier area of astronomy with only questions!

**11:57AM J6.00003 Prize to a Faculty Member for Research in an Undergraduate Institution**. , MICHAEL BROWN, Swarthmore College — Several new experimental results are reported from plasma merging studies at the Swarthmore Spheromak Experiment (SSX) with relevance to collisionless three dimensional magnetic reconnection in laboratory and space plasmas. First, recent high-resolution velocity measurements of impurity ions using ion Doppler spectroscopy (IDS) show bi-directional outflow jets at 10 km/s (nearly the Alfvén speed). Second, ion heating to nearly 10^6 K is observed after reconnection events in a low density kinetic regime. 3D particle simulations reveal a population of trapped ions heated by the outflow. Transient electron heating is inferred from bursts on a 4- channel soft x-ray array. Third, the out-of-plane magnetic field in a reconnection volume shows a quadrupolar structure at the ion inertial scale. Time resolved vector magnetic field measurements on a 3D lattice (B(r,t)) enables this measurement. Each of these measurements will be related to and compared with similar observations in a solar or space context.

3 work supported by DOE and NSF CMSO

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**Sunday, April 13, 2008 10:45AM - 12:33PM**

**Session J7 GHP: Recent Highlights in Hadronic Physics** Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Rose Garden
10:45AM J7.00001 Highlights on Hadronic Physics from Heavy Ion Physics. JAMES DUNLOP, Brookhaven National Laboratory — The program at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory has been a resounding success, leading to qualitative advances in our understanding of both the properties of the universe in its earliest stages and the spin of the proton. The study of this matter, created in the laboratory through collisions between nuclei at high energies, is entering into a new, quantitative phase with upgrades to both the detectors and the collider, termed RHIC II. Limitations of current measurements will be reviewed, along with the upcoming methods to produce high precision quantification of the properties of the matter produced at RHIC.

11:21AM J7.00002 The New Charmonium States. ERIC SWANSON, University of Pittsburgh — A review of the properties and theoretical interpretations of the newly discovered charmonium states is presented.

11:57AM J7.00003 Partial Wave Analysis Results for γp → ωp using Data from CLAS at Jefferson Lab. MIKE WILLIAMS, Carnegie Mellon University — Relativistic quark models predict strong couplings to ωp — relative to Nπ — for some of the missing N* states. Previous searches for these states in γp → ωp have relied solely on differential cross section measurements. I will present final differential cross section and ω spin-flip matrix element measurements obtained from the CLAS g1l1a dataset. Measurements at ~20 points in each of 12 ± 2 bins over the range 1.72 GeV < γ < 2.84 GeV have been made (~2000 total points). These are the first high precision polarization measurements made for ω photoproduction. I will also present partial wave analysis results for this channel. These results are the first to be constrained by precise polarization information. Strong evidence for resonance contributions to γp → ωp has been found.

Sunday, April 13, 2008 10:45AM - 11:57AM — Session J8 DAP: Cosmic Microwave Background and Analysis Techniques Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade A

10:45AM J8.00001 Primordial Non-Gaussianity (fNL) in WMAP data. AMIT YADAV, BENJAMIN WANDELT, University of Illinois at Urbana-Champaign — We present evidence for the detection of primordial non-Gaussianity of the local type (fNL), using the temperature information of the Cosmic Microwave Background (CMB) from the WMAP 3-year data. We employ the bispectrum estimator of non-Gaussianity described in Yadav et al. 2007 which allows us to analyze the entirety of the WMAP data without an arbitrary cut-off in angular scale. Using the combined information from WMAP’s two main science channels up to ℓ_{max} = 750 and the conservative Kp0 foreground mask we find 26.9 < fNL < 146.7 at 95% C.L., with a central value of fNL = 86.8. This corresponds to a rejection of fNL = 0 at more than 99.5% significance. We find that this detection is robust to variations in ℓ_{max}, frequency and masks. We conclude that the WMAP 3-year data disfavors single field slow-roll inflation.

10:57AM J8.00002 Effects of a Primordial Magnetic Field on Low and High Multipoles of the CMB. GRANT MATHES, Univ. Notre Dame, DAI YAMAZAKI, TOSHIKAZU KAJINO, NAOJ, KIYOTOMO ICHIKAWA, RESECU, Univ. Tokyo — The existence of a primordial magnetic field (PMF) would affect the temperature and polarization anisotropies of the cosmic microwave background (CMB). It also provides a plausible explanation for the possible disparity between observations and theoretical fits to the CMB power spectrum. Here we report on numerical calculations of the CMB power spectrum and analyze the correlations between the CMB power spectrum from the PMF and the primary curvature perturbations. We deduce a precise estimate of the PMF effect on all modes of perturbations. We find that the PMF affects not only the CMB TT and TE modes on small angular scales, but also on large angular scales. The introduction of a PMF leads to a better fit to the CMB power spectrum for the higher multipoles, and the fit at lowest multipoles can be used to constrain the correlation of the PMF with density fluctuations for large negative values of the spectral index. Our prediction for the BB mode for a PMF average field strength of B0 = 4.0 nG is consistent with the upper limit on the BB mode deduced from the latest CMB observations. We find that the BB mode is dominated by the vector mode of the PMF for higher multipoles. We also show that by fitting the complete power spectrum one can break the degeneracy between the PMF amplitude and its power spectral index.

10:09AM J8.00003 A search for Lorentz violation in the CMB. MATTHEW MEWES, Marquette University, ALAN KOSTELECKY, Indiana University — Cosmic microwave background radiation provides an excellent opportunity for searching for vacuum birefringence. Rotation in the polarization of electromagnetic radiation is one consequence of birefringence and provides a signature for violations of Lorentz invariance. The extreme distances involved imply that tiny defects in propagation might accumulate to appreciable levels, yielding high sensitivities to possible Lorentz violations.

11:21AM J8.00004 Pico: Parameters for the Impatient Cosmologist. WILLIAM FENDT, University of Illinois at Urbana-Champaign, BENJAMIN WANDELT, University of Illinois at Urbana-Champaign — We present a fast, accurate and robust method of accelerating cosmological parameter estimation. The algorithm, called Pico, can compute the CMB power spectrum, matter transfer function and WMAP likelihood in about 20 milliseconds. This is approximately 1500 times faster than CAMB at default accuracies and 250,000 times faster at high accuracy. For the 9 parameter nonflat case presented here Pico can on average compute the TT, TE and EE spectra to better than 1% of cosmic standard deviation for nearly all ℓ values over a large region of parameter space. By removing the major bottlenecks in parameter estimation codes, Pico decreases the computational time required to explore the parameter space of current cosmological parameter analysis codes for any given CMB and large scale structure data, we show that these power spectra give very accurate 1 and 2 dimensional parameter contours. Training Pico can be done using massively parallel computing resources, including distributed computing projects such as Cosmology@Home.

11:33AM J8.00005 Bayesian Forecasting of Cosmological Parameter Constraints for Future Experiments. RAHUL BISWAS, BENJAMIN WANDELT, University of Illinois at Urbana-Champaign — In the era of precision cosmology, observational efforts are driven by expensive well planned missions. As we move towards more precise measurements, it is thus imperative to estimate the constraints from the Proposed Observational Survey, more accurately. Here, we propose a method of forecasting cosmological parameter constraints from future surveys which go beyond the usual method of Fisher Analysis.

11:45AM J8.00006 Astronomical Data Analysis on Graphics Cards1. PETER MESSMER, Tech-X Corporation, PAUL MULLOWNEY, Tech-X Corp., MICHAEL GALLO, DAVID FILLMORE, BRIAN GRANGER, KEEGAN AMYX, DAVID FILLMORE, Tech-X Corp, TECH-X CORPORATION TEAM — Increasing detector sizes and advanced algorithms make astronomical data analysis tasks computationally demanding. Tools are therefore needed that simplify the development of parallel data analysis algorithms. Modern graphics cards offer a large amount of processing power at low cost and therefore have the potential to benefit these analyses. However, the massively parallel nature of these devices makes them difficult to develop for. In this talk, we present a library of general purpose vector operations that can run on graphics cards. Bindings to widely used data analysis tools, including IDL and Matlab are provided, enabling scientists to take advantage of the enhanced processing power from within a familiar environment. We will present the programming interface and performance results for example applications.

1Work supported by NASA SBIR Phase II Grant #NNG06CA13C and Tech-X Corporation.
10:45AM J10.00001 Highly-Spinning-Black-Hole Binaries, YOSEF ZLOCHOWER, CARLOS LOUSTO, MANUELA CAMPANIELLI, Rochester Institute of Technology — In this talk I will show recent results obtained by the RIT group from simulations of highly-spinning-black-hole binaries using the moving puncture approach, paying particular attention to the phenomena of superkicks, orbital hangup, and cosmic censorship. Simulations of highly spinning binaries are challenging both due to the amount of spurious radiation introduced by the initial data choice, which introduces unwanted eccentricity, and the smallness of the horizons. Accurate results can be obtained with long evolutions and very fine central resolutions.

10:57AM J10.00002 Further insight into gravitational recoil, CARLOS LOUSTO, YOSEF ZLOCHOWER, MANUELA CAMPANIELLI, Rochester Institute of Technology — We test the accuracy of our recently proposed empirical formula to model the recoil velocity imparted to the merger remnant of spinning, unequal-mass black-hole binaries. We study three families of black-hole binary configurations, all with mass ratio $q=3/8$ (to maximize the unequal-mass contribution to the kick) and spins aligned (or counter aligned) with the orbital angular momentum, two with spin configurations chosen to minimize the spin-induced tangential and radial accelerations of the trajectories respectively, and a third family where the trajectories are significantly altered by spin-orbit coupling. We find good agreement between the measured and predicted recoil velocities for the first two families, and reasonable agreement for the third. We also re-examine our original generic binary configuration which led to the discovery of extremely large spin-driven recoil velocities and inspired our empirical formula, and find reasonable agreement between the predicted and measured recoil speeds.

11:09AM J10.00003 The final spin in unbound black hole mergers, PABLO LAGUNA, Penn State, MATTHEW WASHIK, Drexel University, RICHARD MATZNER, University of Texas at Austin, DEIRDRE SHOEMAKER, FRANK HERRMANN, IAN HINDER, Penn State — The spin of the final black hole produced by the merger of a binary black hole system is approximately determined by the combination of orbital angular momentum, spins of the coalescing black holes and radiated angular momentum at the point when the binary enters the plunge. In circular or low eccentricity inspirals, numerical simulations have shown that, although there is a substantial amount (~20%) of angular momentum radiated, the spin of the final black hole is dominated by the orbital angular momentum. To further explore the role played by the orbital angular momentum, we present results from parabolic and hyperbolic encounters. Because the radiated angular momentum for these mergers is significantly lower, we are able to construct initial configurations that yield spin flipping as well as spinning-up of the final black hole significantly different from those in circular orbits.

1Work supported by NSF PHY-0554436 and PHY-0554343

11:21AM J10.00004 Robustness of Binary Black Hole Mergers in the Presence of Spurious Radiation, TANJA BODE, DEIRDRE SHOEMAKER, FRANK HERRMANN, IAN HINDER, Penn State — We present an investigation into how sensitive the last orbits and merger of binary black hole systems are to the presence of spurious radiation in the initial data. Our numerical experiments consist of a binary black hole system starting the last couple of orbits before merger with additional spurious radiation centered at the origin and fixed initial angular momentum. As the energy in the added spurious radiation increases, the binary is invariably hardened for the cases we tested, i.e. the merger of the two black holes is hastened. The change in merger time becomes significant when the additional energy provided by the spurious radiation increases the $M_{ADM}$ of the spacetime by about 1%. While the final masses of the black holes increase due to partial absorption of the radiation, the final spins remain constant to within our numerical accuracy. We conjecture that the spurious radiation is primarily increasing the eccentricity of the orbit and secondarily increasing the mass of the black holes while propagating out to infinity.

2Center for Gravitational Wave Physics, Penn State

11:33AM J10.00005 High-spin binary black hole mergers, PEDRO MARRONETTI, WOLFGANG TICHY, Florida Atlantic University, BERND BRÜGMANN, ULRICH SPERHAKE, University of Jena, JOSÉ GONZÁLEZ, Universidad Michoacana de San Nicolas — We study identical mass black hole binaries with spins perpendicular to the binary's orbital plane. These binaries have individual spins ranging from $s/m^2=-0.90$ to $0.90$, $(s_1 = s_2$ in all cases) which is near the limit possible with standard Bowen-York puncture initial data. The extreme cases correspond to the largest initial spin simulations to date. Our results expand the parameter space covered by Rezzolla et al. and, when combining both data sets, we obtain estimations for the minimum and maximum values for the intrinsic angular momenta of the remnant of binary black hole mergers of $J/M^2 = 0.341(4)$ and $0.951(4)$ respectively.

1Work supported by NSF grants PHY-0555644 and PHY-0652874

11:45AM J10.00006 The Final Spin of Black Hole Binaries, ERIK SCHNETTER, Louisiana State University — The evolution from the initial to the final state of a generic binary black hole system can be viewed as black box, with just a few input and output parameters such as masses and spins. Combining a series of numerical simulations and certain reasonable assumptions, we derive accurate analytic expressions describing the final state after the merger process, for the case of aligned spins and non-eccentric orbits.

1AEl/CCT collaboration

11:57AM J10.00007 Simulations of binary black holes with spin, WOLFGANG TICHY, PEDRO MARRONETTI, Florida Atlantic University — We present results of simulations of spinning black hole binaries on initially quasi-circular orbits. Our simulations cover several orbits as well as the merger and ringdown phases. We compare the initial and final mass and angular momentum of each system, and give error estimates for our results.

1This work is supported by NSF grant PHY-0652874

12:09PM J10.00008 Describing Waveforms from Nonspinning Black Hole Binaries, WILLIAM DARIAN BOGGS, University of Maryland College Park, JOHN G. BAKER, JOAN CENTRELLA, BERNARD J. KELLY, NASA GSFC, SEAN T. MCMILLIANS, University of Maryland, College Park, JAMES R. VAN METER, NASA GSFC — Following successful simulations of the inspiral and merger of a black hole binary, the parameter space survey of black hole binary simulations is underway. Equal-mass simulations and waveforms have been studied thoroughly. Mergers with various spins on the individual black holes have been simulated. We have simulated the last several orbits of nonspinning mergers with mass ratios up to 1.6. We focus on the waveforms from such mergers, with an emphasis on interpreting the phase evolution by a simple heuristic model.
12:21PM J10.00009 Comparison of numerical relativity simulations with post-Newtonian expansions, Padé and EOB models, ABDUL HUSSEIN MROUE, Cornell University, SAUL. TEUKOLSKY, LAWRENCE KIDDER, HARALD PFEIFFER, MICHAEL BOYLE, MARK SCHEEL, ALESSANDRA BUONANNO, YI PAN, CORNELL TEAM, CALTECH TEAM, U. MARYLAND TEAM — In order to detect GWs and measure the physical parameters of coalescing black hole binaries, a large bank of templates is required to accurately represent the GW waveforms emitted by these binaries. Since Numerical Relativity cannot densely sample the parameter space, different analytical methods are developed to compute these waveforms. We compare our recent numerical gravitational waveforms with those from post-Newtonian formulae, their various Padé transforms, and the different Effective-One-Body models.

Sunday, April 13, 2008 10:45AM - 12:33PM — Session J11 DPF: QCD and Colliders | Hyatt Regency St. Louis Riverfront (formerly Adam"039;s Mark Hotel), St. Louis B

10:45AM J11.00001 Direct Photon Production in Association with a Heavy Quark, TVZETALINA STAVREVA, JOSEPH F. OWENS, Florida State University — The inclusive cross section for a direct photon and a heavy quark (charm or bottom), \( p + p(\bar{p}) \rightarrow \gamma + Q + X \), is calculated up to second order in the strong coupling constant \( \alpha_s \). The photon fragmentation function, which is of order \( \alpha_s/\alpha_s \), where \( \alpha_s \) is the electromagnetic coupling constant, needs to be convoluted with all QCD subprocesses of order \( \alpha_s^3 \) containing a heavy quark in the final state so that the cross section is complete to next-to-leading order (NLO). This calculation extends previous efforts by including this NLO contribution. The cross section for photon plus heavy quark production can provide a useful check of the method used for the calculation of the heavy quark's parton distribution functions, which are currently determined with the use of the Altarelli-Parisi equation. The dependence of the cross section on the photon and heavy quark transverse momenta and rapidities will be examined. Predictions for both the Tevatron and the LHC will be presented.

10:57AM J11.00002 Search for transitions in bottomonium involving a single pseudoscalar meson, TODD PEDLAR, Luther College, CLEO COLLABORATION — Using approximately 9 million \( \Upsilon(2S) \) decays and 6 million \( \Upsilon(3S) \) decays, the CLEO Collaboration has searched for rare hadronic transitions between the \( T \) states involving a single \( n^0 \) or \( \eta \) meson. We present the results of the measurements or upper limits for each of the following transitions: \( \Upsilon(3S) \rightarrow \Upsilon(1S)(n^0 \text{ or } \eta) \), \( \Upsilon(3S) \rightarrow \Upsilon(2S)n^0 \), \( \Upsilon(2S) \rightarrow \Upsilon(1S)(n^0 \text{ or } \eta) \).

11:09AM J11.00003 Hadronic jet-vertex association in a high-luminosity environment at the LHC\(^1\), DAVID MILLER, Stanford/SLAC, ATLAS COLLABORATION — The LHC physics program will ultimately probe not only the highest energies ever produced in the laboratory but also the most numerous and frequent collisions between hadronic particles ever. These particle luminosities, much above the current Tevatron values, will produce hadronic jets from simultaneous uncorrelated proton-proton collisions in unprecedented numbers, thus introducing challenges for jet identification and association with the primary collision vertices, jet energy measurements and missing energy resolution. We continue work first introduced by the Tevatron experiments to combine tracking information with calorimeter jets in order to disentangle this jet background. Using an algorithm which assigns a jet-vertex association probability, jet selection is shown to be insensitive to the contributions from these “pile-up” collisions, which is essential for the many physics analyses dependent on event jet multiplicity. Furthermore, jet-by-jet multiple interaction energy corrections are now possible and improvements to the primary vertex identification from jet-vertex association are gained for several interesting physics processes.

11:21AM J11.00004 Jet Shape Studies at CMS, PELIN KURT, Cukurova University/Fermilab, CMS COLLABORATION — CMS detector will detect high transverse momentum jets produced in the final state of proton-proton collisions at the center of mass energy of 14 TeV. These data will allow to measure jet shapes, defined as the fractional transverse momentum distribution inside the jets as a function of the distance from the jet axis. Since jet shapes are sensitive to parton shower and hadronization processes, they provide a good test of perturbative QCD predictions. Calorimeter towers are used to reconstruct the differential jet shapes. We present studies performed to measure jet shapes in CMS using different clustering algorithms.

11:33AM J11.00005 ABSTRACT WITHDRAWN —

11:45AM J11.00006 Using Drell-Yan to Probe the Underlying Event in Run 2 at CDF, DEEPAK KAR, RICK FIELD, University of Florida, CDF COLLABORATION — We study the event topology in Drell-Yan lepton-pair production in proton-antiproton collisions at 1.96 TeV in Run 2 at CDF. We use the direction of the lepton-pair at a event by event basis to define three regions of rapidity, " away", "transverse." The "transverse" region is very sensitive to the "underlying event" and is separated into a MAX and MIN "transverse" region, which helps separate the "hard component" (initial and final-state radiation) from the "beam-beam remnant" and multiple parton interaction components of the scattering. The data are corrected to the particle level and are then compared with the QCD Monte Carlo models. The properties of the "underlying event" are examined as a function of the lepton-pair invariant mass and transverse momentum. The data are also compared with a previous analysis on the behavior of the "underlying event" in high transverse momentum jet production. The goal is to improve our understanding and modeling of the high energy collider events to allow for more precise predictions at the LHC.

11:57AM J11.00007 A Numerical Approach to Coulomb Gauge QCD, HRAYR MATEVOSYAN, Nuclear Theory Center, Indiana University, ADAM SZCZEPAJNIK, Nuclear Theory Center and Department of Physics, Indiana University, PATRICK BOWMAN, Centre of Theoretical Chemistry and Physics, Institute of Fundamental Sciences, Massey University (Auckland) — We calculate the ghost two-point function in Coulomb gauge QCD with a simple model vacuum gluon wavefunction using Monte-Carlo integration. This approach extends the previous analytic studies of the ghost propagator in this ansatz, where a ladder-rainbow expansion was unavailable for calculating the path integral over gluon field configurations. This approach allows us to study the possible critical behavior of the coupling constant, as well as the Coulomb potential derived from the ghost dressing function.

12:09PM J11.00008 A parametrization of the baryon octet and decuplet masses, PHUOC HA, Towson University — We construct a general parametrization of the baryon octet and decuplet masses including the three-body terms using the unit operator and the symmetry-breaking factors, \( M^0 = \text{diag} (0, 1, 0) \) and \( M^1 = \text{diag} (0, 0, 1) \), in conjunction with the spin operators. Our parametrization which is equivalent to the usual chiral description is the first general parametrization in the context of effective field theory in the “quark” representation, where it has the minimal number of operators needed to describe all the octet and decuplet masses. We show that at two-loop level in the heavy-baryon chiral effective field theory, contributions of the three-body terms are cancelled and the general expression for baryon masses is reduced to the independent one- and two body operators. Our parametrization is particularly useful to an analysis of the baryon mass splittings due to both hypercharge-breaking and isospin-breaking effects.
12:21PM J11.00009 Relations Among Helicity Amplitudes for $2 \rightarrow 2$ Scattering in the Parke-Shadmi Spin Basis, GREGORY MAHLON, Penn State Mont Alto — When studying angular correlations in high energy scattering processes, it has proven fruitful to consider spin bases other than the traditional helicity basis in situations where the final state particles have significant masses (e.g. top quarks, electroweak gauge bosons, Higgs bosons, etc.). We present differential identities connecting the helicity amplitudes for different total spin projections of the final state. These relations may be used as simple cross-checks of calculations of these amplitudes or as a means of deriving additional amplitudes, bypassing the need to calculate the entire set of amplitudes for a specific process explicitly.

Sunday, April 13, 2008 10:45AM - 12:33PM – Session J12 DPF: Top I Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis C

10:45AM J12.00001 Measurement of the Top Quark Mass at D0 Using the Matrix-Element Method in the Dilepton Channel, ALEXANDER GROHS JEAN, LMU, Munich, D0 COLLABORATION — We report on the measurement of the top quark mass using candidates in the dilepton final state. For each event, a probability based on the differential cross section for production is calculated as a function of the top mass. The top mass is extracted by maximizing a likelihood constructed as the product of the single event probabilities. The measurement is based on 1 fb$^{-1}$ of data.

10:57AM J12.00002 Measurement of the ttbar Cross Section in the Dilepton Channel with the D0 Detector, MARION ARTHAUD, DAPNIA/SPP, Saclay, D0 COLLABORATION — We present the ttbar production cross measurement using dilepton events. This analysis is based on data taken with the D0 detector at the Fermilab Tevatron collider at a center-of-mass energy of 1.96 TeV. The data corresponding to an integrated luminosity of about 1.1 fb$^{-1}$ were recorded in the years 2002 to 2006.

11:09AM J12.00003 Top quark mass measurement in the dilepton channel at CDF using a neural network event selection and matrix element method, RAVI SHEKHAR, Duke University, CDF COLLABORATION — We present a measurement of the top quark mass using events in the dilepton decay channel. The events used in this analysis are selected using a genetically-evolved artificial neural network that is optimized directly for precision in the top quark mass measurements. This is the first application of this method in high energy physics. We extract the top quark mass from a probability that a given event is consistent with tt decay in the dilepton channel. The probability is evaluated using the differential cross-section for tt production and decay. The effect of background events in the sample is accounted for by evaluating differential cross sections for major background processes. Using 2 fb$^{-1}$ of pp data collected at the CDF II detector, we measure $m_t = 171.2 \pm 2.7$(stat.) $\pm 2.9$(syst.) GeV/c$^2$. We discuss the gain in sensitivity due to the use of the evolving neural network.

11:21AM J12.00004 Study of differential distributions of top quarks, JIRI KVITA, Charles University, Prague, D0 COLLABORATION — The study of kinematics of top quark pairs produced at Fermilab Tevatron Collider can test Standard Model production and decay of the system or look for new physics. Differential distributions can validate current generators and their level of description of the top quark pairs and provide a detailed window on QCD dynamics of a unique heavy diquark system at large scales. We present measurements of differential distributions of top quarks produced in pairs in $p\bar{p}$ collisions recorded by the DZero experiment. Events containing a high-$p_T$ lepton, large missing transverse energy, and four or more jets were chosen from the 0.9 fb$^{-1}$ Run IIa data sample. At least one of the jets was required to be identified as a b jet. A constrained kinematic fit associated these decay products with the individual top quarks. The measured spectra, binned in several observables, are compared to those obtained from the Monte Carlo simulation. We focus on the transverse momentum of the top quark and the top pair system as well as the system invariant mass and the azimuthal decorrelation between top quarks.

11:33AM J12.00005 Simultaneous measurement of the ratio $B(t \rightarrow Wb)/B(t \rightarrow Wq)$ and the top quark pair production cross section with the D0 detector at $\sqrt{s} = 1.96$ TeV, SUHARYO SUMOWIDAGDO, Florida State University, D0 COLLABORATION — We present the first simultaneous measurement of the ratio of branching fractions, $R = B(t \rightarrow Wb)/B(t \rightarrow Wq)$, with q being a d, s, or b quark, and the top quark pair production cross section $\sigma_{tt}$ in the lepton plus jets channel using 0.9 fb$^{-1}$ of $p\bar{p}$ collision data at $\sqrt{s} = 1.96$ TeV collected with the D0 detector. We extract $R$ and $\sigma_{tt}$ by analyzing samples of events with 0, 1 and $\geq 2$ identified b jets.

11:45AM J12.00006 Measurement of the ttbar Cross Section in the Lepton+track Channel with the D0 Detector, ROBERT WAGNER, Princeton University, D0 COLLABORATION — The production cross-section for top-antitop quark pairs from proton-antiproton collisions at $\sqrt{s} = 1.96$ TeV was measured in the dilepton channel. The top quark decays almost exclusively to a W boson final state, and in the dilepton channel both of the W bosons from the top-antitop pair decay into either an electron or muon, possibly through an intermediary tau. The measurement was made using a lepton-1-track selection method, which selects events where only one lepton was fully identified by the detector and the second lepton is identified by an isolated track in the tracking system. The lepton-1-track selection is added to the fully identified channels to increase the sensitivity of the combined dilepton channel measurement. This work was performed at the D0 detector at the Tevatron collider, using about 1 fb$^{-1}$ of integrated luminosity.

11:57AM J12.00007 Measurement of the top quark mass in the lepton+track sample at CDF, MARCO TROVATO, University of Pisa, CDF COLLABORATION — We report on a measurement of the top quark mass in the lepton-1-track sample of $t\bar{t}$ events at CDF. We use a neural network tagging algorithm. We discuss the results which both within the context of the Standard Model and a semi model-independent approach of a non-SM production mechanism of a tau lepton in top quark decay.

12:09PM J12.00008 Measurement of the ttbar Production Cross Section at D0 Using Lepton + Hadronic tau Events, FLORENT LACROIX, LPC, Clermont Ferrand, D0 COLLABORATION — We present the measurement of top quark-antiquark pair production in the lepton-1-hadronic tau channel using approximately 0.9 fb$^{-1}$ of D0 data. We select events with one isolated high $p_T$ electron or muon, one isolated hadronic tau, high missing transverse energy, and two high $p_T$ jets. One or more of the jets are required to have originated from a b quark by applying a neural network tagging algorithm. We discuss the results which both within the context of the Standard Model and a semi model-independent approach of a non-SM production mechanism of a tau lepton in top quark decay.
12:21PM J12.00009 Measurement of the ttbar Production Cross Section at D0 Using tau+Jets Events, MIKHAIL AROV, Louisiana Tech University, D0 COLLABORATION — We report on the measurement of the ttbar production cross section with candidate events in which the W boson from one of the top quarks decays into a tau lepton and the associated neutrino while the other W boson decays to a quark-antiquark pair. We select events in which the tau lepton subsequently decays to one or three charged hadrons plus neutral hadrons and a neutrino. The measurement is based on 1 fb⁻¹ of data. The signal was discriminated from background using kinematic information and by requiring an identified b jet.

Sunday, April 13, 2008 10:45AM - 12:33PM — Session J13 DNP: Minisymposium on Hard Probes of the Quark-Gluon Plasma Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis F

10:45AM J13.00001 Hard Probes of the Quark-Gluon Plasma: Introduction and Overview. ABHIJIT MAJUMDER, Duke University — The Quark-Gluon Plasma formed at the Relativistic Heavy-Ion collider (RHIC) is strongly interacting. Hard probes present the most rigorous tool in the study of the partonic substructure of the produced matter, where, the presence of a hard scale allows for the use of techniques based on perturbative QCD and factorization. These include a series of single jet observables, multi-particle jet correlations, jet-medium correlations as well as heavy quark and electromagnetic probes. The different approaches and approximation schemes used in the study of jet modification in dense matter are reviewed and major results reported. A variety of new jet correlation observables are outlined and their possible explanations and implications for the structure of the produced matter discussed.

11:21AM J13.00002 Constraining energy-loss model parameters using multiple high-pt observables at RHIC. CRAIG OGILVIE, Iowa State University, PHENIX COLLABORATION — High-momentum partons lose energy as they travel through the dense QGP that is formed at RHIC. In a recent publication PHENIX has performed a quantitative comparison between various parton energy-loss models and experimental data on single-particle suppression (R_{AA}) versus pt. These data provided a constraint on the model parameters of medium opacity. It is important to also compare these model calculations with other complementary observables, such as R_{AA} as a function of the reaction plane, or the suppression of two-particle correlations. Using other observables can more fully test energy-loss models, since a broader suite of observables not only tests for consistency but may also offer better sensitivity to the model parameters and sample path-length distributions differently than R_{AA}. In this talk I will present the status of using PHENIX results to constrain the theoretical models of energy-loss at RHIC.

11:33AM J13.00003 Pseudorapidity asymmetry at high p_T in p(d)A collisions\(^1\). ADEOLA ADELUYI, GERGELY BARNAFOLDI, GEORGE FAI, Center for Nuclear Research, Department of Physics, Kent State University, Kent, OH 44242, USA, PETER LEVAI, MTA KFKI RMKI, Research Institute for Particle and Nuclear Physics, P.O. Box 49, Budapest 1525, Hungary — We calculate pseudorapidity (η) asymmetry in pp and dAu collisions in the framework of a next-to-leading order (NLO) pQCD-improved parton model. Our calculations are applicable in a wide range of kinematically accessible transverse momenta, p_T. The calculations\(^1\) are tuned to describe existing spectra from pp collisions and asymmetric systems at midrapidity and large rapidities at FNAL and RHIC energies. We investigate the roles of nuclear shadowing and multiple scattering on the observed pseudorapidity asymmetry\(^3\). Using this framework, we make predictions for pseudorapidity asymmetries at high p_T and high η at a wide range of energies up to LHC.\(^1\) [1] A. Adeluyi and G. Fai, Phys. Rev. C 76, 054904 (2007) [2] G.G. Barnafoldi, P. Levai, G. Papp and G. Fai, Nucl. Phys. A 749, 291 (2005) [3] B.I. Abelev et al. [STAR Collaboration], Phys. Rev. C 76, 054903 (2007)

\(^1\)Partially supported by DE-FG02-86ER40251

11:45AM J13.00004 Prototype Performance of Novel Muon Telescope Detector at STAR. DAVID TLUSTY, LIUJIAN RUAN, Brookhaven National Laboratory, STAR COLLABORATION — A large area of muon telescope detector is proposed to measure momenta of momentum at a few GeV/c at mid-rapidity, allowing for the detection of di-muon pairs from QGP thermal radiation, quarkonia, light vector mesons, possible correlations of quarks and gluons as resonances in QGP, and Drell-Yan production as well as the measurement of heavy flavor hadrons through their semi-leptonic decays into single muons. The R&D research has been carried out for this large area Muon Telescope Detector (MTD). The multi-gap resistive plate chamber technology with large modules and long strips and two-end readout (Long-MRPC) was used for this research. The results from cosmic ray and beam test will be presented to address intrinsic timing and spatial resolution for Long-MRPC. Besides, a single prototype of MTD was installed in STAR during the 200 GeV Au+Au run in spring 2007. The detector consists of a long-MRPC layer between two layers of scintillator planes. They are placed outside of the magnet yoke that serves as hadron absorber. We will present results from this prototype run. Muon identification capability, timing and spatial resolution will be reported. We also discuss the implication of these tests on the physics performance and capabilities of full scale detector.

11:57AM J13.00005 A Monte Carlo Event Generator for Ultra Peripheral Collisions. JOSEPH BUTTERWORTH, Creighton University, SPENCER KLEIN, YURY GORBUNOV, JOAKIM NYSTRAND, JANET SEGGER — Ultra peripheral collisions occur when the nuclei pass one another without overlapping. The intense electric fields present can be treated as a flux of photons; these photons can interact with the nucleus producing a range of particles, including vector mesons (Upsilon, J/Psi, rho, ...) and pairs of oppositely charged pions. In order to effectively study ultra peripheral collisions at the STAR experiment, a Monte Carlo event generator was created to optimize particle selection criteria and to assess on whether rarer physics processes are possible to study. The FORTRAN program was initially designed in 1995 to simulate ultra-relativistic Au-Au interactions. Since then, changes have been made to the program to fit the needs of newer experiments. I will present the kinds of physics that are modeled by the program such as photonuclear and photon-photon interactions, comparisons to data, and the current and future upgrades being made to the Monte Carlo. The upgrades include the consolidation of versions into C++, additional final states, asymmetric collisions of arbitrary nuclei, and improved expandability.

12:09PM J13.00006 Analysis of Neutral Rho Decays from Ultra-Peripheral Collisions in Deuteron-Gold Interactions. STEPHEN HANSEN, Creighton University, STAR COLLABORATION — This work will investigate the production of the neutral rho meson in ultra-peripheral collisions (UPCs) of deuteron and gold (dAu) nuclei. A UPC occurs when the impact parameter for the collision of two charged particles is greater than the sum of their radii. The resulting interaction is electromagnetic in nature. These nuclei are collided in the Solenoidal Tracker at RHIC (STAR), a particle detector at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory. I will present the kinematic variables of the produced rho mesons and compare them to Monte Carlo simulations. A ratio of rho production to direct pion production will also be presented. I will also show how Monte Carlo simulations can be used to determine the geometric acceptance and reconstruction efficiency and to help differentiate between coherent and incoherent production.
The shallow potential we use is generated by correcting the M3Y double-folding potential for the effect of the nuclear incompressibility, which we simulate by a repulsive, effective.

The low-energy data can only be achieved by determining the fusion from ingoing wave boundary conditions that are imposed at the minimum of the pocket.

Bucharest, Romania. — The hindrance of heavy-ion fusion at extreme sub-barrier energies is now a well established phenomenon, which has been observed experimentally in many medium-heavy systems [1]. The low-energy data can be explained fairly accurately by coupled-channels calculations that use a shallow.


From thermo- to pycno-nuclear reactions in multi-component dense matter.

LEANDRO GASQUES, University of Lisbon, MICHAEL WIESCHER, University of Notre Dame, DIMITRI YAKOVLEV, Ioffe Physico-Technical Institute, JINA COLLABORATION — We model the crust of accreting neutron stars with molecular dynamics simulations involving complex compositions with many different impurities as predicted by Gupta et al. electron capture calculations. We present results for the phase structure [1], thermal conductivity, and screening factors for nuclear reactions [2]. We find a lattice structure with a high thermal conductivity, instead of an amorphous solid, and we discuss the distribution of impurities. These thermal conductivity results agree with X-Ray observations of crust cooling for neutron stars after extended outbursts.

We find that screening factors for the enhancement of thermonuclear reactions may be insensitive to the large scale distribution of impurities in the solid. Fusion of neutron rich oxygen isotopes such as $^{24}$O may be an important heat source at densities near ten to the eleventh g/cm$^3$. Indeed these and similar fusion reactions may be important to heat the crust to carbon ignition temperatures in superbursts. [1] C. J. Horowitz, D. K. Berry, and E. F. Brown, PRE75 (2007) 066101. [2] C. J. Horowitz, H. Dussan, and D. K. Berry, arXiv:0710.5714.

From thermo- to pycno-nuclear reactions in multi-component dense matter.

LEANDRO GASQUES, University of Lisbon, MICHAEL WIESCHER, University of Notre Dame, DIMITRI YAKOVLEV, Ioffe Physico-Technical Institute, JINA COLLABORATION — We model the crust of accreting neutron stars with molecular dynamics simulations involving complex compositions with many different impurities as predicted by Gupta el al. electron capture calculations. We present results for the phase structure [1], thermal conductivity, and screening factors for nuclear reactions [2]. We find a lattice structure with a high thermal conductivity, instead of an amorphous solid, and we discuss the distribution of impurities. These thermal conductivity results agree with X-Ray observations of crust cooling for neutron stars after extended outbursts.

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Work supported (H.E.) by the U.S. Department of Energy, Office of Nuclear Physics, under Contract No. DE-AC02-06CH11357.
12:21 PM J14.00007 Aspects and Reaction Rates for Pycnonuclear Fusion at High Densities

MARY BEARD, MICHAEL WIESCHER, University of Notre Dame, ANATOLI AFANASJEV, Mississippi State University, LEANDRO GASQUES, Australian National University, DIMA YAKOVLEV, Ioffe Physical Technical Institute — Pycnonuclear reactions are of great importance in the nuclear astrophysics of high density conditions such as the centers of white dwarf starts, and the deep layers of accreting neutron stars. We present here a single phenomenological expression for the calculation of pycnonuclear reaction rates which is not only valid in mixed component plasma, but can also be extended to cover the five stellar burning regimes.

12:33 PM J14.00008 The JINA Reaclib Project

RICHARD CYBURT — Nuclear astrophysics is a rich and vital field of study, using experimental/theoretical input for calculations of processes that create the elements we are made from. In order to facilitate this research further, the Joint Institute for Nuclear Astrophysics (JINA) has created a public, web-based database for thermonuclear reaction rates. Data are stored in the standard Reaclib format and are continually updated as new data or new compilations become available. A versioning system has been adopted to keep track of new rates. Recommended rate libraries representing “snap shots” of the live database are stored for users wanting a fixed/unchanging set of rates. The database and its use will be presented with emphasis on its role in nuclear astrophysics calculations. For more information, see the JINA Reaclib website: http://www.nscl.msu.edu/~reacelib.

Sunday, April 13, 2008 10:45 AM - 12:21 PM

Session J15 DNP: Nuclear Reactions and Astrophysics

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis H

10:45 AM J15.00001 Nuclear Reaction Dynamics of the $^{10}\text{B}(d, n)$11C Reaction Below 160 keV

S. STAVE, M.W. AHMED, M.A. BLACKSTON, A.S. CROWELL, S.S. HENSHAW, C.R. HOWELL, P. KINGSBERRY, B.A. PERDUE, H.R. WELLER, Duke U. & TUNL, R. BOYLE, P. ROSSI, A.J. ANOTOLAK, Sandia National Lab, R.M. PRIOR, M.C. SPRAKER, NGCSU & TUNL — Data were taken at TUNL to investigate the plausibility of using low energy deuterons and the $^{10}\text{B}(d, n)$11C reaction as a source of 6.3 MeV neutrons. An analysis of the data at incident deuteron energies of 160 keV and 140 keV and neutron angles between 0° and 150° indicates an n0 neutron cross section that is lower than previous estimates by at least two orders of magnitude. In order to gain insight into the reaction dynamics at these low energies the cross section results have been compared with results from calculations using the distorted wave Born approximation (DWBA).

1Supported by US DOE Grant Nos. DE-FG02-97ER41033 and DE-FG02-97ER41046 and SNL. Sandia is a multi-program Lab operated by Sandia Corp., a Lockheed Martin Co., for the US DOE’s National Nuclear Security Administration under contract DE-AC04-94AL85000.

10:57 AM J15.00002 Study of the $^{11}\text{B}(\vec{p}, \alpha)^8\text{Be}$ Reaction using polarized protons below 5.1 MeV.

S. STAVE, MOHAMMAD AHMED, MATTHEW BLACKSTON, BRENTH PERDUE, HENRY R. WELLER, Duke/TUNL, RALPH FRANCE, TOM LEWIS, J.P. METZKER, Georgia College and State University, RICHARD PRIOR, MARK SPRAKER, North Georgia College and State University, ALEX KUSNEZOV, St. Lawrence University — Cross section and analyzing power data have been obtained for proton energies between 0.4 and 5.1 MeV. The experiment was performed using the TUNL polarized proton beam, eight Silicon-surface barrier detectors, and an enriched $^1\text{B}$ target deposited on a thin carbon backing. Energies below 1.1 MeV were obtained using an Aluminum degrading foil. Preliminary results indicate analyzing powers for the $^{11}\text{B}(\vec{p}, \alpha)^8\text{Be}$ reaction at the ~ 0.675 MeV resonance which are consistent with zero and a cross section angular distribution which is isotropic. Previous measurements of the absolute angle integrated cross section on top of this resonance have produced results having significant variations. Preliminary results for analyzing powers and cross sections will be presented along with experimental details and possible implications for energy production in an aneutronic $^{11}\text{B} + p$ fusion reactor.

1This work was partially supported by the USDOE grant Nos. DE-FG02-97ER41033 and DE-FG02-97ER41046.

11:09 AM J15.00003 Neutron Asymmetry Parameterization of a Dispersive Optical Model

JONATHAN MUELLER, Department of Physics, Washington University, ROBERT CHARITY, LEE SOBOTKA, Department of Chemistry, Washington University, WILLEM DICKHOFF, Department of Physics, Washington University — We have recently applied a Dispersive Optical Model (DOM) analysis to a series of calcium isotopes. The proton spectroscopic factors as a function of asymmetry were determined, but the neutron dependence on asymmetry was not. Consideration of either Gamow-Teller or collective E2 strength yield different asymmetry dependencies (for neutrons) than the global OM parameterizations.

Neutron elastic scattering n+48Ca can distinguish between these possibilities. With such data, extrapolation of neutron spectroscopic factors towards the n-drip line will be more robust.

11:21 AM J15.00004 Survey of Neutron Spectroscopic Factors for Z = 8 to 28 nuclei

JENNY LEE, NSCL, JINA, and Dept of Physics and Astronomy, Michigan State University, East Lansing, Michigan, 48824, USA, P. DAI, Physics Department, Chinese University of Hong Kong, Shatin, Hong Kong, China, M. HOROI, Department of Physics, Central Michigan University, Mount Pleasant, Michigan 48859, USA, W.G. LYNCH, NSCL, JINA, and Dept of Physics and Astronomy, Michigan State University, East Lansing, Michigan, 48824, USA, S.C. SU, Physics Department, Chinese University of Hong Kong, Shatin, Hong Kong, China, M.B. TSANG, S. WARREN, NSCL, JINA, and Dept of Physics and Astronomy, Michigan State University, East Lansing, Michigan, 48824, USA — Spectroscopic factor (SF) is a fundamental quantity in nuclear physics. SFS are extensively used from nuclear structure to astrophysical network calculations. They provide an important probe to test how well shell models describe the structure of nuclei. In this talk, we will compare neutron spectroscopic factors obtained for the sd shell nuclei, Ca, Ti, Cr and Ni isotopes to shell models. Of particular interests are the comparisons of data with different shell model interactions in these regions including the evolution of single particle states around Z =20, N =27 and N =29 regions.

1This work is supported by the National Science Foundation under Grants PHY-0555893, PHY-0060067 and PHY 0216783.

11:33 AM J15.00005 Dispersive Optical Model and Isospin

S.J. WALDECKER, W.H. DICKHOFF, Washington University in St. Louis — Dispersive optical model (DOM) analyses successfully describe scattering and bound-state data for 40Ca, 42Ca, 44Ca, and 48Ca. The global fits agree very well with the data, but the extent to which these DOM calculations can be extrapolated to systems not included in the fit is not sufficiently constrained for neutrons. Bound-state data for Ca isotopes show clear trends when analyzed as a function of isospin, suggesting that isospin is an important ingredient to include in any extrapolation. The effects of including explicit isospin dependence in the DOM potentials are explored in this contribution.


11:45 AM J15.00006 Results of the First TOF Mass Measurements at NSCL, M. MATOS, A. ESTRADA, M. AMTHOR, D. BAZIN, A. BECCERIL, T. ELLIOT, D. GALAVIZ, A. GADE, G. LORUSO, J. PEREIRA, M. PORTILLO, A. ROGERS, H. SCHATZ, A. STOLZ, MSU, D. SHAPIRA, ORNL, E. SMITH, OSU, M. WALLACE, LANL — Time-of-Flight mass measurements technique, recently developed at the NSCL, was used to measure masses of exotic neutron-rich nuclides in the Fe region, important for n-process calculations as well as for calculations of processes occurring in the crust of accreting neutron stars. Results from the experiment will be presented and discussed.

11:57 AM J15.00007 Calculation of Level Densities for Nuclei Far from the Line of Stability1, SHALEEN SHUKLA, STEVEN GRIMES, Ohio University — Nuclear level densities provide crucial input in any statistical model calculation of compound nucleus decay, applied to the various processes like the study of fission hindrance in heavy nuclei, the yields of evaporation residues to populate certain exotic nuclei, production of heavy elements in stellar processes etc. We calculate nuclear level densities for nuclei near the drip line. We use a single fermion model with non interacting fermions and spectral distribution methods which allow moments to be calculated in huge spaces using a fairly small sum. We shall present results some typical results for mass number in the range 40 - 100. We are also investigating the effect of two-body interaction on these nuclei and would also present some results showing its effect.

12:09 PM J15.00008 Microscopic theory of incorporating resonances in the mean field, M.S. SABRA, F.B. MALIK, Southern Illinois University, Carbondale, IL — Starting from a many body Hamiltonian, containing one and two body operators, a microscopic theory has been developed to incorporate resonances in the mean field for the scattering theory. The results for the elastic scattering will be presented. It indicates that the structure of the S-matrix obtained differs from some of the theories applied on an ad hoc way to describe elastic scattering. The derived theory has been applied to α - α scattering in the energy range 3.5-40.0 MeV (lab), where the phase shift analysis indicates a sudden jump, thereby implying the occurrence of a resonance. The data has been analyzed by incorporating resonance term in the mean field which has its roots in the energy-density functional approach. This leads to improvement of the fits to the data. This analysis will be compared to the analysis obtained by the methods where a resonance term is usually added on an ad hoc way to the optical potential.

Sunday, April 13, 2008 10:45AM - 11:45AM — Session J16: Physics Education I

10:45 AM J16.00001 Lessons from the Rickover summer experience for high school students, D.M. SVELNYS, Rickover Naval Academy, C.J. LISTER, Argonne National Laboratory, S.M. FISCHER, DePaul University and Argonne National Laboratory — For the last two years we have organized a one week summer school at Argonne National Laboratory for high school students from the Rickover Naval Academy, which is a magnet school in Chicago. The school has many facets; “hands-on” experiments, visits to facilities in the laboratory, science lectures, discussion of scientific careers, and report writing. The school is aimed at showing students the possibilities of science careers at all levels, and linking the science they learn in class to cutting edge research topics. We are still learning from the students how to best achieve these goals. I will discuss the development of the school course content and the feedback we have had for the various course elements. We are growing the school to encompass courses in Chemistry and Biology this year, and have a goal of increasing the number of schools participating in the out-years. This research was supported by the DOE Office of Nuclear Physics under contract DE-AC02-06CH11357.

10:57 AM J16.00002 EPPOG Masterclass comes to the US, KENNETH CECIRE, Hampton University — For the past several years, the European Particle Physics Outreach Group has run a series of spring Masterclasses in particle physics for high school students. Students work with physicists to analyze event displays from LEP, draw conclusions, and then discuss what they’ve learned with students in other locations via a videoconference moderated from CERN. In 2006 and 2007, US students were able to participate in limited numbers in the European Masterclasses. This year, a US Masterclass was conducted with videoconferences moderated from the CMS Remote Operations Center at Fermilab. This presentation is to discuss the results of this experience, the prospects for the future, and the potential for LHC awareness in the US.

11:09 AM J16.00003 Computers in Science education, a new way to teach physics and mathematics?, MORTEN JORTH-JENSEN, Department of Physics, University of Oslo, Norway, HANS PETTER LANGTANGEN, Simula Research Laboratory, Oslo, Norway, KNUT MØRINGEN, Department of Informatics, University of Oslo, Norway, ANDERS MALTHE-SØRENSEN, ARNT INGE VISTNES, Department of Physics, University of Oslo, Norway — We present the Computers in Science Education project at the University of Oslo, where computational topics are baked into our undergraduate curriculum of most of our bachelor programs from the very first semester. The first semester consists of courses in traditional Calculus, mathematical modelling and computer science. Topic such as solving differential equations numerically are introduced the first semester and the students learn to program such equation using modern computing languages, in addition to the standard analytical procedures. The first semester provides the basis for further introduction of computational topics. These are gradually baked into many other undergraduate courses in mathematics and the sciences. We focus on teaching our students to use general programming tools in solving physics problems, in addition to the classical analytic problems. Our students handle nuclear decay, applied to the various processes like the study of fission hindrance in heavy nuclei, the yields of evaporation residues to populate certain exotic nuclei, production of heavy elements in stellar processes etc. We calculate nuclear level densities for nuclei near the drip line. We use a single fermion model with non interacting fermions and spectral distribution methods which allow moments to be calculated in huge spaces using a fairly small sum. We shall present results some typical results for mass number in the range 40 - 100. We are also investigating the effect of two-body interaction on these nuclei and would also present some results showing its effect.

11:21 AM J16.00004 Blogging in the physics classroom: A research-based approach to shaping students’ attitudes towards physics, KATHERINE GARRETT, GINTARAS DUDA, Creighton University — Even though there has been a tremendous amount of research done in how to help students learn physics, students are still coming away missing a crucial piece of the puzzle: why bother with physics? Students learn fundamental laws and how to calculate, but come out of a general physics course without a deep understanding of how physics has transformed the world around them. In other words, they get the “how” but not the “why”. Studies have shown that students leave introductory physics courses almost universally less excited about the topic than when they came in. This presentation will detail an experiment to address this problem: a course weblog or “blog” which discusses real-world applications of physics and engages students in discussion and thinking outside of class. Student response to the blog was overwhelmingly positive, with students claiming that the blog made the things we studied in the classroom come alive for them and seem much more relevant.
radiative shocks (RS) in astrophysics and in laboratory. Accurate RS cooling. We have solved the hydrodynamic equations including non-equilibrium ionization, non-equilibration of temperatures, and, currently a hot topic, cosmic ray acceleration. I will discuss several of these aspects, mainly from an observational point of view. A prominent place in this talk is reserved for the bright remnant Cas A, which shows evidence for radio-active Ti-44 in its interior, a bipolar explosion, and cosmic ray acceleration.

11:50AM 10HE.00003 Analytic Approach to the Stability of Standing Accretion Shocks, MARTIN LAMING, Naval Research Laboratory — We explore an analytic model of the accretion shock in the postbounce phase of a core-collapse supernova explosion. We find growing oscillations of the shock in the l = 1 and 2 modes, in agreement with a variety of existing numerical simulations. For modest values of the ratio of the outer accretion shock to that of the inner boundary to the shocked flow, the instability appears to derive from the growth of trapped sound waves, whereas at higher values, postshock advection clearly plays a role. Thus, the model described here may relate to the different mechanisms of instability recently advocated by Blondin & Mezzacappa and by Foglizzo and collaborators.

12:15PM 10HE.00004 LUNCH BREAK —

2:25PM 10HE.00006 Radiative Transfer in Type Ia Supernovae, DANIEL KASEN, University of California, Santa Cruz — Some white dwarf stars die in a thermonuclear runaway leading to complete stellar disruption within seconds — a Type Ia supernova. The material ejected in that explosion will shine brightly for months, powered by the decay of freshly synthesized radioactive isotopes. Multi-physics hydrodynamical codes are now simulating the first violent seconds of the event, and a treatment of the subsequent radiation transport is needed to calculate predictions of the observable light curves, spectral evolution, and spectropolarization. Here I discuss Monte Carlo techniques for addressing multi-group time-dependent radiative transfer in 3-dimensional, rapidly expanding plasmas, where the densities are low and non-LTE effects can be important. I compare our model calculations directly to astronomical observations, and discuss how the simulations are helping us understand the progenitors and explosion mechanism of Type Ia supernovae, as well as refining their applicability as probes of cosmological expansion.

2:50PM 10HE.00007 BREAK —

Sunday, April 13, 2008 1:30PM - 3:18PM —
Session L2 DPF: Neutrinos and Astrophysics Hyatt Regency St. Louis Riverfront (formerly Adam039:s Mark Hotel), St. Louis D
Sunday, April 13, 2008 1:30PM - 3:18PM –
Session L3 DNP DAP: The Physics of X-Ray Bursts
Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis E

1:30PM L3.00001 The complex and puzzling phenomenology of thermonuclear X-ray bursts
, DUNCAN GALLOWAY, Monash University — Thirty years of observations of thermonuclear (type-I) bursts from accreting neutron stars have revealed a surprisingly rich spectrum of behavior. A few sources which have been studied intensively offer confirmed examples of the three classes of ignition predicted theoretically, and these systems serve as crucial test-cases for numerical models. However, the behavior of the majority of systems cannot be fully reconciled with theoretical predictions suggesting there is additional physics at work. Some of these burst behavior are not amenable to study via observations of individual sources, typically because they occur rarely and/or unpredictably. A more promising approach lies in combining data from multiple sources. To date, many thousands of bursts have been detected by various instruments, and new observations are continually adding to the available data. I will describe the results from one such study, involving all the public observations to date made by the Rossi X-ray Timing Explorer (RXTE), totalling 1185 bursts from 48 sources. The capabilities of the Proportional Counter Array onboard RXTE enable detailed studies of photospheric radius-expansion, weak bursts (including short recurrence time bursts) and burst oscillations. The two most prolific bursters in the sample exhibit distinctly different bursting properties, suggesting different accreted compositions in the accreted fuel, and highlighting the diversity in burst behaviour which must be considered when combining burst samples. Large burst samples can also be used to measure the global variation of burst properties as a function of accretion rate, to compare with theoretical models. I will also describe a successor project, the Multi-Instrument Burst ARchive (MINBAR), which aims to collate all bursts observed by modern instruments to enable comprehensive future studies of rare events and broad-scale behavior.

2:06PM L3.00002 Models of X-ray Bursts
, RANDALL COOPER, Harvard University — Type I X-ray bursts are thermonuclear explosions that occur on the surfaces of neutron stars that accrete matter from their binary companions. Since their discovery over 30 years ago, observers have detected thousands of X-ray bursts, while theorists have developed X-ray burst models with ever-increasing complexity and sophistication. While there is now some accord between theory and observations, a few severe discrepancies remain. Chief among them is the range of accretion rates within which thermonuclear burning triggers X-ray bursts. In this talk, I will review our current understanding of the physics of the thermal instability that triggers X-ray bursts, with an emphasis on the pertinent nuclear reactions. In particular, I will discuss the roles that both the hot CNO cycles and their breakout reactions $^{15}\text{O}$(a,$\gamma$)$^{19}\text{Ne}$ and $^{18}\text{Ne}$(a,$\gamma$)$^{21}\text{Na}$ play in the stability of thermonuclear burning and the rising phase of X-ray bursts.

2:42PM L3.00003 Progress in nuclear physics experiments for the study of X-ray bursts
, WANPENG TAN, University of Notre Dame — Neutron stars in close binary star systems often accrete matter from their companion star. Thermonuclear ignition of the accreted material in the atmosphere of the neutron star leads to a thermonuclear explosion which is observed as an X-ray burst occurring periodically between hours and days, depending on the accretion rate. However, the underlying nuclear processes that power the X-ray bursts are often difficult to measure in accelerator-based laboratories. In this talk, I will discuss recent experimental progress in nuclear physics for the input of X-ray bursts model simulations. In particular, I will present new experiments on the measurements of nuclear breakout reactions from the hot CNO cycle that are critical to the ignition conditions of X-ray bursts. Recent measurements of reaction rates along the $\alpha$- and $\alpha$$^\prime$- process path that determine the X-ray burst light curves will also be discussed. Astrophysical implications of the experimental results will be explored within the context of X-ray burst models.

1Work supported by the Joint Institute for Nuclear Astrophysics

Sunday, April 13, 2008 1:30PM - 3:18PM –
Session L4 FED: Why We Should Double the Number of Undergraduate Degrees in Physics
Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade B

1:30PM L4.00001 Statistics and Rationale for the Doubling Initiative
, THEODORE HODAPP, American Physical Society — The early 1960's saw a huge increase in the number of physics majors, reaching an all time peak of just over 6000 per year. While the number plummeted in the next four decades, it has finally seen a resurgence to just above 5000. The American Physical Society along with the American Association of Physics Teachers recently endorsed a call to double the number of undergraduate physics majors over the next decade. The main focus of this effort is to increase both the number of high school physics teachers and the fraction of women and under-represented minorities studying physics. In addition, a physics degree prepares an undergraduate with excellent skills that will serve her or him for a variety of occupations both in the sciences and in other fields. Astrophysical implications of the experimental results will be explored within the context of X-ray burst models.

2:06PM L4.00002 SPIN-UP and the Recent Increase in the Number of Undergraduate Physics Majors
, ROBERT HILBORN, University of Nebraska-Lincoln — The SPIN-UP report [R. C. Hilborn, R. H. Howes, and K. S. Krane, Strategic Programs for Innovations in Undergraduate Physics: Project Report (American Association of Physics Teachers, College Park, Maryland, 2003) (http://www.aapt.org/Projects/ntfup.cfml) analyzed 21 undergraduate physics programs that had achieved growth in the number of undergraduate majors in the late 1990s when most physics departments had experienced substantial declines. The report identified several common features of “thriving” undergraduate physics programs. Subsequently, many departments have used the SPIN-UP report to develop plans to enhance their undergraduate programs. (See the AAPT publication Guidelines for Self-Study and External Evaluation of Undergraduate Physics Programs.) In this talk I will present an analysis of several physics programs that have achieved substantial (80% or more) growth in their undergraduate programs in recent years. The principles identified in SPIN-UP seem to explain the growth in these departments’ programs.

3SPIN-UP was supported by grants from the ExxonMobil Foundation, AAPT, APS, and AIP.

2:06PM L5.00002 The Auger Observatory, JAMES CRONIN, University of Chicago — No abstract available.

2:42PM L5.00003 Ice Cube, ALBRECHT KARLE, University of Wisconsin — No abstract available.

Sunday, April 13, 2008 1:30PM - 3:18PM –
Session L5 DAP: Ultra-High Energy Cosmic Rays and Neutrinos


2:06PM L5.00002 The Auger Observatory, JAMES CRONIN, University of Chicago — No abstract available.

2:42PM L5.00003 Ice Cube, ALBRECHT KARLE, University of Wisconsin — No abstract available.

Sunday, April 13, 2008 1:30PM - 3:18PM –
Session L6 FPS: Nuclear Forensics

1:30PM L6.00001 TBD, MICHAEL K. EVENSON, Defense Threat Reduction Agency — -

2:06PM L6.00002 Nuclear Forensics: Report of the AAAS/APS Working Group, BENN TANNENBAUM, AAAS — This report was produced by a Working Group of the American Physical Society’s Program on Public Affairs in conjunction with the American Association for the Advancement of Science for Center for Science, Technology and Security Policy. The primary purpose of this report is to provide the Congress, U.S. government agencies and other institutions involved in nuclear forensics with a clear unclassified statement of the state of the art of nuclear forensics; an assessment of its potential for preventing and identifying unattributed nuclear attacks; and identification of the policies, resources and human talent to fulfill that potential. In the course of its work, the Working Group observed that nuclear forensics was an essential part of the overall nuclear attribution process, which aims at identifying the origin of unidentified nuclear weapon material and, in the event, an unidentified nuclear explosion. A credible nuclear attribution capability and in particular nuclear forensics capability could deter essential participants in the chain of actors needed to smuggle nuclear weapon material or carry out a nuclear terrorist act and could also encourage states to better secure such materials and weapons. The Working Group also noted that nuclear forensics result would take some time to obtain and that neither internal coordination, nor international arrangements, nor the state of qualified personnel and needed equipment were currently enough to minimize the time needed to reach reliable results in an emergency such as would be caused by a nuclear detonation or the intercept of a weapon-size quantity of material. The Working Group assesses international cooperation to be crucial for forensics to work, since the material would likely come from inadequately documented foreign sources. In addition, international participation, if properly managed, could enhance the credibility of the deterrent effect of attribution. Finally the Working Group notes that the U.S. forensics capability involved a number of agencies and other groups that would have to cooperate rapidly in an emergency and that suitable exercises to ensure such cooperation were needed.

2:42PM L6.00003 Nuclear Forensics and Attribution: A National Laboratory Perspective, HOWARD L. HALL, Global Security Principal Directorate, Lawrence Livermore National Laboratory, P.O. Box 808 L-180, Livermore, CA 94550 — Current capabilities in technical nuclear forensics - the extraction of information from nuclear and/or radiological materials to support the attribution of a nuclear incident to material sources, transit routes, and ultimately perpetrator identity - derive largely from three sources: nuclear weapons testing and surveillance programs of the Cold War, advances in analytical chemistry and materials characterization techniques, and abilities to perform “conventional” forensics (e.g., fingerprints) on radiologically contaminated items. Leveraging that scientific infrastructure has provided a baseline capability to the nation, but we are only beginning to explore the scientific challenges that stand between today's capabilities and tomorrow's requirements. These scientific challenges include radically rethinking radioanalytical chemistry approaches, developing rapidly deployable sampling and analysis systems for field applications, and improving analytical instrumentation. Coupled with the ability to measure a signature faster or more exquisitely, we must also develop the ability to interpret those signatures for meaning. This requires understanding of the physics and chemistry of nuclear materials processes well beyond our current level - especially since we are unlikely to ever have direct access to all potential sources of nuclear threat materials.

Sunday, April 13, 2008 1:30PM - 3:18PM –
Session L7 GGR: Ground-based Gravitational Wave Searches

1:30PM L7.00001 Searches for bursts of gravitational waves with LIGO, GEO and Virgo, E. KATSAVOUNIDIS, MIT — The LIGO, GEO and Virgo laser interferometers completed in October 2007 their most recent science runs (fifth science run, S5, for LIGO/GEO and first Virgo science run, VSR1). This presents the most sensitive and longest in duration coordinated observation by the global network of gravitational wave detectors. One of the astrophysical searches that we pursue using data from the laser interferometers targets sources of short-duration, arbitrary-shaped gravitational wave signals. Such signals, referred to as bursts, may accompany events like core-collapse supernovae, the merger phase of coalescing binary compact stars and gamma-ray bursts (GRBs). In this talk we will present the current status of the analysis of S5 and VSR1 data for such bursts of gravitational radiation. We will also discuss the advantages of the coordinated observations offered by the global network of detectors. We will finally highlight our first S5 result attained in a search for gravitational wave bursts in association with GRB070201 and discuss the prospects of ongoing burst searches.

*This is presented on behalf of the LIGO Scientific Collaboration and the Virgo Collaboration.*
2:06PM L7.00002 Searches for gravitational waves from the inspiral of binary neutron stars and black holes. DUNCAN BROWN1, Syracuse University — We report on searches for gravitational waves from the coalescence of compact binaries in data from the LIGO detectors. These searches target signals from inspiraling binary systems with total masses less than $0.5 M_{\odot}$ and for inspiral waves associated with short hard gamma ray bursts. We will also give an overview of ongoing searches being performed by the LIGO Scientific and Virgo collaborations.

1For the LIGO Scientific Collaboration and the Virgo Collaboration.

2:42PM L7.00003 Extending our reach: the next decade of GW detectors. SAMUEL WALDMAN, California Institute of Technology — The international gravitational wave community has successfully completed a year of data taking with first generation detectors operating at design sensitivity and looks forward to a decade of upgrades. The upgrades will improve the sensitivity by approximately an order of magnitude with a thousand-fold increase in the detection rate. This talk will review the current and proposed GW detectors planned for operation by 2018.

Sunday, April 13, 2008 1:30PM - 3:06PM –
Session L8 DAP: Neutron Stars, Pulsars, and Black Holes Hyatt Regency St. Louis Riverfront (formerly Adam039:s Mark Hotel), Promenade A

1:30PM L8.00001 Nuclear Equation of State of High Density Matter. JIRINA STONE2, University of Oxford, UK — The density and temperature dependence of energy per particle of a system (the Equation of State - EOS) is a fundamental ingredient of all models of nuclear matter and stars. As baryons and leptons form the main components of all stars, knowledge of nuclear physics and weak interactions is essential for correct understanding of birth, life and death of stars. We compare results obtained with EOS’s based on a selection of well established nucleon-nucleon effective interactions in comparison with new results from the quark-meson coupling model and the ORNL-Oxford effective potential. Properties of cold non-rotating and rapidly rotating neutron stars, calculated on the basis of the models, are presented and discussed.

1 Supported by US DOE grant DE-FG02-94ER40834
2 University of Maryland, College Park, USA

1:42PM L8.00002 A parametrized equation of state for neutron-star matter. JOHN L. FRIEDMAN, JOCELYN S. READ, BENJAMIN D. LACKEY, University of Wisconsin-Milwaukee, BENJAMIN OWEN, The Pennsylvania State University — Astrophysical constraints on the nuclear equation of state above nuclear density have been studied simply by looking at which members of the set of candidate equations of state are ruled out by observations of neutron stars. A systematic study of observational constraints requires a parameterized equation of state with a set of parameters smaller than the number of neutron star properties that have been measured or will have been measured in the next several years. And the set must be large enough to accurately approximate the large set of candidate EOS’s. We find that a parametrized EOS based on piecewise polytropes with three free parameters matches to about 5% rms error the universe of candidate EOS’s at densities below the central density of 1.4 $M_{\odot}$ stars. Adding observations of more massive stars constrains the higher density part of the EOS and requires an additional parameter.

1 NSF PHY-0503366, NASA NNG05GB99G, NSF PHY-0555628, NSF PHY-0114375

1:54PM L8.00003 Astrophysical constraints on the parameter space of the neutron-star equation of state. BENJAMIN LACKEY, JOCELYN READ, University of Wisconsin-Milwaukee, BENJAMIN OWEN, Penn State, JOHN FRIEDMAN, University of Wisconsin-Milwaukee — The neutron-star equation of state is largely known above nuclear density but can be accurately parameterized by only four free parameters. The parameter space may be constrained with observations of neutron stars, and we find the constraint surfaces associated with causality and with observed limits on masses, radii, redshift, moment of inertia, and spin frequency. There are only a few hard (model-independent) constraints; of these, the most stringent is associated with the largest observed neutron-star masses, and this constraint only restricts the parameter space to one side of a constraint surface. Anticipated future observations of moments of inertia of stars with known masses can more sharply constrain the parameter space, confining the parameter space to a surface.

2:06PM L8.00004 Spin Frequencies and Magnetic Fields of Neutron Stars: Implications of the kHz QPOs Recently Discovered in Circinus X-1. STRATOS BOUTLOUKOS, FREDERICK LAMB, University of Illinois — The paired kilohertz quasi-periodic oscillations (kHz QPOs) recently discovered in the X-ray emission of Cir X-1 are generally similar to those seen in disk-accreting neutron stars with relatively weak magnetic fields, establishing that the compact object in the Cir X-1 system is such a star. Periodic oscillations have not yet been detected from Cir X-1, so its spin rate has not yet been measured directly. In many stars that produce kHz QPOs, the frequency separation $\Delta \nu$ of the QPO pair is equal or roughly equal to the stellar spin rate $\nu_s$ or to $\nu_s/2$. The involvement of the stellar spin in producing $\Delta \nu$ indicates that the magnetic fields of these stars are dynamically important. If the mechanism that produces the kilohertz QPOs is similar in all stars, the value of $\Delta \nu$ provides a rough estimate of the star’s spin rate. In Cir X-1, $\Delta \nu$ varies by 167 Hz, from ~230 Hz to ~500 Hz, the largest variation seen so far in any neutron star. The frequency $\nu_a$ of the upper kHz QPO in Cir X-1 is up to a factor of three smaller than is typical. The low observed values of $\nu_a$, and the large variation of $\Delta \nu$ challenge current models for the generation of kHz QPOs. We discuss the implications of the observed properties of the Cir X-1 kHz QPOs for mechanisms for generating the kHz QPOs in Cir X-1 and other accreting neutron stars. This research was supported in part by NASA grant NAG 5-12030, NSF grant AST 0709015, and funds of the Fortner Endowed Chair at Illinois.

2:18PM L8.00005 A Model of Waveform Variations and Intermittency in Accretion-Powered Millisecond Pulsars FREDERICK K. LAMB, STRATOS BOUTLOUKOS, ALEXANDER CLARE, DANIEL DORRIS, SANDOR VAN WASSENHOVE, WENFEI YU, U. Illinois, COLEMAN MILLER, U. Maryland — We suggest that the accretion-powered X-ray oscillations of most accreting millisecond pulsars (MSPs) are weak and nearly sinusoidal because they are aligned or nearly aligned rotators. The properties of the emitting region on the neutron star surface are determined by the geometry and strength of the star’s magnetic field and where accreting plasma enters the magnetosphere. They are therefore expected to change with time as the character of the flow in the inner disk changes. X-ray emission and general relativistic ray-tracing computations show that if accretion-powered MSPs are nearly aligned, modest changes in the size and shape of the emitting region can explain the pulse waveform variations and large changes in apparent spin-frequency observed in many of them and the sudden appearance and disappearance of pulsations (intermittency) observed in some. This model can also explain why accretion-powered periodic oscillations have not been detected from many neutron stars in low-mass X-ray binary systems.

1This research was supported in part by NASA grant NAG 5-12030, NSF grant AST 0709015, and funds of the Fortner Endowed Chair at Illinois, and by NSF grant AST 0708424 at Maryland.
2:30PM L8.00006 Pulsar kicks with electrons in Landau levels and active, sterile neutrinos

LEONARD KISSLINGER, Carnegie Mellon University — Very large velocities of pulsars have been observed: called pulsar kicks. The electrons produced with the anti-neutrinos during the first about 50 seconds of the supernova event are in Landau levels due to the strong magnetic field. This leads to asymmetry in the neutrino momentum. We derive the momentum given the proto-neutron star during the time when the neutrino sphere is near the surface of the proto-neutron star and find that highly luminous neutron stars could receive a velocity of more than 1000 km/s, as has been observed[1]. During the first 10 seconds, when most of the energy emitted by neutrinos occurs, only neutrinos at the edge of the neutrino sphere are emitted, and little asymmetric momentum is produced unless the neutrinos oscillate to sterile neutrinos. We use a model with two sterile neutrinos obtained by fits to the MiniBoone and LSND experiments, and show that large pulsar kicks can be obtained[2]


2:42PM L8.00007 Particle energization and radiation in magnetized black hole accretion

EDISON LIANG, GUY HILBURN, Rice University, SIMING LIU, HUI LI, Los Alamos National Laboratory, CHARLES GAMMIE, University of Illinois — We study nonthermal electron heating by MHD turbulence generated by the magneto-rotational instability in magnetized accretion flows onto black holes. Using a combination of relativistic MHD, Fokker-Planck and Monte Carlo simulations, we study the spectral and temporal properties of the radiation output, and their dependence on the disk input parameters. Of particular interest are the roles of the magnetic field and density of the initial plasma.

Supported in part by National Science Foundation grant No. PHY 06-52448

Sunday, April 13, 2008 1:30PM - 3:06PM –
Session L10 GGR: Mathematical and Post-Newtonian Relativity
Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis A

1:30PM L10.00001 Black hole in a post-Newtonian tidal field

ERIC POISSON, University of Guelph — In this talk I describe an ongoing project that aims to determine the tidal distortion of a nonrotating black hole when it is placed in the presence of other nearby bodies. The context of this work is very general, but the focus here will be on post-Newtonian tidal environments. The first part of the project consists of calculating the black-hole metric in terms of arbitrary tidal fields that characterize the tidal environment. In the second part the tidal fields are determined by inserting the black hole within a global spacetime that contains the other bodies. Here the global spacetime contains an arbitrary number of bodies that move slowly under their weak mutual gravity, and its metric is described by post-Newtonian theory. We calculate the tidal fields acting on the black hole and express them in terms of the post-Newtonian potentials. Because the post-Newtonian metric of the N-body system is not valid in the strongly-gravitating environment of the black hole, we work in a buffer region around the black hole where the metric and the post-Newtonian metric are both valid. The tidal fields are determined by matching the two metrics in this buffer region.

1:42PM L10.00002 Metric of a Nonrotating Black Hole in a Tidal Environment

IGOR VLASOV, ERIC POISSON, University of Guelph — We consider the perturbed field of a Schwarzschild black hole with a mass $M$ much smaller than the local radius of curvature $R$ generated by the external Universe. We discuss light-cone coordinates used to represent the combined metric of the black hole and external matter. The metric of the external Universe is found as an expansion in STF harmonics, then the Einstein equations are solved for the full metric at the first nonlinear order $O((M/R)^4)$. We discuss the gauge freedom and analyze the solution.

1:54PM L10.00003 Three-body equations of motion in successive post-Newtonian approximations

HIROYUKI NAKANO, CARLOS LOUSTO, Rochester Institute of Technology — There are periodic solutions to the equal-mass three-body (and N-body) problem in Newtonian gravity. The figure-eight solution is one of them. In this paper, we discuss its solution in the first and second post-Newtonian approximations to General Relativity. To do so we derive the canonical equations of motion in the ADM gauge from the three-body Hamiltonian. We then integrate those equations numerically, showing that quantities such as the energy, linear and angular momenta are conserved down to numerical error. We also study the scaling of the initial parameters with the physical size of the triple system. In this way we can assess when general relativistic results are important and we determine that this occur for distances of the order of 100M, with M the total mass of the system. For distances much closer than those, presumably the system would completely collapse due to gravitational radiation. This sets up a natural cut-off to Newtonian N-body simulations. The method can also be used to dynamically provide initial parameters for subsequent full nonlinear numerical simulations.

2:06PM L10.00004 Angular momentum at null infinity

ADAM HELFER, University of Missouri — I will describe a definition of angular momentum at null infinity which appears to be satisfactory. It is natural, resolves the supertranslation problem, allows a computation of fluxes, and gives physically plausible characterizations of spin and center of mass. It is a development of Penrose’s twistor-based ideas, but I will recast it in conventional (non-twistor) terms. The supertranslation problem prevents a consistent treatment of gravitational angular momentum in special-relativistic terms. The resolution of this difficulty turns out to be that the angular momentum is not a pure $j$-term, but acquires higher-$j$ terms as well. These higher-$j$ terms fit into the theory just so as to give geometrically natural definitions of spin and center of mass. Remarkably, too, they correspond precisely to the Bondi shear. So shear and angular momentum should be regarded as different elements of a single unified concept. While this definition reproduces conventional results in weak-field slow-motion limits, it has novel features in more general situations. Systems which are asymmetric and highly dynamical may radiate angular momentum (including “conventional,” $j = 1$, angular momentum) at first order in the gravitational wave strength. Astrophysical systems might have measurable “hops” and spin-changes associated with such emissions of center-of-mass or spin angular momentum.

2:18PM L10.00005 Beyond Discrete Vacuum Spacetimes, JONATHAN MCDONALD, WARNER MILLER, Florida Atlantic University — In applications to pre-geometric models of quantum gravity, one expects matter to play an important role in the geometry of the spacetime. Such models often posit that the matter fields play a crucial role in the determination of the spacetime geometry. However, it is not well understood at a fundamental level how one couples matter into the Regge geometry. In order to better understand the nature of such theories that rely on Regge Calculus, we must first gain a better understanding of the role of matter in a lattice spacetime, and particularly focus on the role of spinors in Regge Calculus. Since spinors are fundamental to fermionic fields, this investigation is crucial in understanding fermionic coupling to discrete spacetime. Our focus is primarily on the geometric interpretation of the fields on the lattice geometry with a goal on understanding the dynamic coupling between the fields and the geometry.

2:30PM L10.00006 Measuring the Scalar Curvature with Clocks and Photons: Voronoi-Delaunay Lattices in Regge Calculus, WARNER MILLER, JONATHAN MCDONALD, Florida Atlantic University — The Riemann scalar curvature plays a central role in Einstein’s geometric theory of gravity. We describe a new geometric construction of this scalar curvature invariant at an event (vertex) in a discrete spacetime geometry. This allows one to constructively measure the scalar curvature using only clocks and photons. Given recent interest in discrete pre-geometric models of quantum gravity, we believe it is ever so important to reconstruct the curvature scalar with respect to a finite number of communicating observers. This derivation makes use of a fundamental lattice cell built from elements inherited from both the original simplicial (Delaunay) spacetime and its circumcentric dual (Voronoi) lattice. The orthogonality properties between these two lattices yield an expression for the vertex-based scalar curvature which is strikingly similar to the corresponding hinge-based expression in Regge Calculus (deficit angle per unit Voronoi dual area). In particular, we show that the scalar curvature is simply a vertex-based weighted average of deficits per weighted average of dual areas.

2:42PM L10.00007 Geometrization of Electromagnetism in Purely Affine and Metric-Affine Gravity, NIKODEM POPLAWSKI, Indiana University — The purely affine Lagrangian for linear electrodynamics, that has the form of the Maxwell Lagrangian in which the metric tensor is replaced by the symmetrized Ricci tensor and the electromagnetic field tensor by the tensor of homothetic curvature, is dynamically equivalent to the Einstein-Maxwell equations in the metric-affine and metric formulation. We apply to a purely affine Lagrangian the Legendre transformation with respect to the tensor of homothetic curvature to show that the corresponding Legendre term and the new Hamiltonian density are related to the metric-affine Maxwell-Palatini Lagrangian for the electromagnetic field. Therefore the purely affine picture, in addition to generating the gravitational Lagrangian that is linear in the curvature, justifies why the electromagnetic Lagrangian is quadratic in the electromagnetic field.

2:54PM L10.00008 A modification of Einstein-Schrodinger theory which closely approximates Einstein-Weinberg-Salam theory, JAMES SHIFFLETT, Washington University in St. Louis — The Lambda-Renormalized Einstein-Schrodinger theory is a modification of the original Einstein-Schrodinger theory in which a cosmological constant term is added to the Lagrangian, and this theory has been shown to closely approximate Einstein-Maxwell theory. Here we generalize this theory to non-Abelian fields by allowing the fields to be composed of 2x2 Hermitian matrices, and we consider the case where the symmetric part of the fields are multiples of the identity matrix. The resulting theory incorporates the U(1) and SU(2) gauge terms of the Weinberg-Salam Lagrangian, and when the rest of the Weinberg-Salam Lagrangian is included, we get a close approximation to Einstein-Weinberg-Salam theory. In particular, the field equations match those of Einstein-Weinberg-Salam theory except for additional terms which are $\times 10^{-13}$ of the usual terms for worst-case field strengths and rates of change accessible to measurement. The Lagrangian density is invariant under U(1) and SU(2) gauge transformations.

$^1$This work supported in part by NSF PHY 06-52448

Sunday, April 13, 2008 1:30PM - 3:18PM –
Session L11 DPF: Charm Physics

1:30PM L11.00001 Evidence for $D^0$-$\bar{D^0}$ Mixing Using the CDF II Detector, NAGESH KULKARNI, Wayne State University, CDF COLLABORATION — We measure the time dependence of the ratio of decay rates for the rare decay $D^0 \rightarrow K^+\pi^-$ to the Cabibbo-favored decay $D^0 \rightarrow K^-\pi^+$. We use a signal of $12.7 \times 10^3 D^0 \rightarrow K^-\pi^+$ decays with proper decay times between 0.75 and 10 mean $D^0$ lifetimes. The data sample was recorded with the CDF II detector at the Fermilab Tevatron and corresponds to an integrated luminosity of 1.5 fb$^{-1}$ for $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV. We search for $D^0$-$\bar{D^0}$ mixing and measure the mixing parameters to be $\delta_{CP} = (3.04 \pm 0.85) \times 10^{-3}$, $\gamma = (8.5 \pm 7.6) \times 10^{-3}$, and $\delta = (0.12 \pm 0.055) \times 10^{-3}$. We report Bayesian probability contours in the $\tau^2$-$\gamma^2$ plane and find that the data are inconsistent with the no-mixing hypothesis with a probability equivalent to 3.8 Gaussian standard deviations. Potential updates to the analysis will be presented.

1:42PM L11.00002 ABSTRACT WITHDRAWN –

1:54PM L11.00003 Measurements of $D$ decay at CLEO-c related to the determination of the unitarity triangle angle $\gamma$, LAUREN MARTIN, Oxford University, CLEO COLLABORATION — One of the principal goals of flavour physics is the accurate determination of the unitarity triangle angle $\gamma$. Several of the theoretically cleanest strategies to determine $\gamma$ use $B \rightarrow DK$ decays, where the $D$ is either a $D^*$ or $D^0$ decaying to the same hadronic final state. The full exploitation of these decays requires excellent knowledge of the parameters and amplitudes of the $D$ decay, particularly if the $D$ decays to a three or four-body final state. The best environment to determine the $D$-decay parameters are quantum correlated $D^0\bar{D^0}$ decays produced in $e^+e^-$ collisions at a centre-of-mass energy equal to the mass of the $\psi(3770)$. We report preliminary results from the CLEO-c experiment of some of the parameters relevant to the determination $\gamma$ in $B$-decay.

2:06PM L11.00004 Study of the decay $D^0 \rightarrow \gamma\gamma$, JAMES MORRIS, Ohio State University, BABAR COLLABORATION — We present preliminary results for the decay $D^0 \rightarrow \gamma\gamma$ using data collected with the BaBar detector at the PEP-II asymmetric $e^+e^-$ collider at SLAC. We fully reconstruct the decay $D^0 \rightarrow D^0\pi^+$, $D^0 \rightarrow \gamma\gamma$. These predominantly long-range, FCNC decays provide a test for physics beyond the standard model.

2:18PM L11.00005 Radiative decays of $\chi_c$ states to light vector mesons, JAKE BENNETT, Roanoke College, CLEO COLLABORATION — Using approximately 25 million decays of the $\psi(2S)$ collected with the CLEO-c detector we study decays of the $\chi_c$ states produced in radiative decays of the $\psi(2S)$. In particular we present results of a search for rare radiative decays of the $\chi_c$ states to light vector mesons.
We present a Dalitz plot analysis of the decays $D^0 \rightarrow K^0_S \pi^+ \pi^-$ and $D^0 \rightarrow K^0_S K^+ K^-$. We use a high statistics data sample collected with the BaBar detector at the PEP-II asymmetric-energy $e^+e^-$ collider at SLAC. The results of this analysis are a critical input for the determination of the Cabibbo-Kobayashi-Maskawa CP-violating phase $\gamma$ using a $D$ Dalitz analysis of $B^\pm \rightarrow D^{(*)} K^{(*)} \ell^\pm \nu_{\ell}$ decays.

We present a preliminary result of the search for the decay $D^0 \rightarrow \omega \eta$ where $D^0$ comes from the decay $D^{*+} \rightarrow D^{0}\pi^+$. We use a high statistics data sample collected with the BaBar detector at the PEP-II asymmetric $e^+e^-$ collider at SLAC.

First measurement of the form factors in $D \rightarrow \rho e^+\nu_e$. We use a high statistics data sample collected with the CLEO-c detector at the $\psi(3770)$ resonance, we present improved measurements of absolute branching fractions in the semileptonic decays $D^0 \rightarrow \rho^- e^+\nu_e$ and $D^+ \rightarrow \rho^+ e^+\nu_e$. By performing a four-dimensional maximum likelihood fit to the distribution of kinematic variables, we have measured, for the first time, the semileptonic form factors in these modes. An extension of the analysis with the $\approx 800 \text{ pb}^{-1}$ complete data set is also discussed.

We present a preliminary result of the search for the decay $D^0 \rightarrow K^* \eta$, and $D^0 \rightarrow K^* \eta$ where $D^0$ comes from the decay $D^{*+} \rightarrow D^{0}\pi^+$. We use a high statistics data sample collected with the BaBar detector at the PEP-II asymmetric $e^+e^-$ collider at SLAC.

Search for Associated Production of Z and Higgs Bosons in nu nu bb Final States. We present a preliminary result of the search for the decay $D^0 \rightarrow \omega \eta$ where $D^0$ comes from the decay $D^{*+} \rightarrow D^{0}\pi^+$. We use a high statistics data sample collected with the BaBar detector at the PEP-II asymmetric $e^+e^-$ collider at SLAC.

Search for Associated Production of W and Higgs Bosons in lnu bb Final States. We present a preliminary result of the search for the decay $D^0 \rightarrow \omega \eta$ where $D^0$ comes from the decay $D^{*+} \rightarrow D^{0}\pi^+$. We use a high statistics data sample collected with the BaBar detector at the PEP-II asymmetric $e^+e^-$ collider at SLAC.

Search for Associated Production of Z and Higgs Bosons in nu nu bb Final States. We present a preliminary result of the search for the decay $D^0 \rightarrow \omega \eta$ where $D^0$ comes from the decay $D^{*+} \rightarrow D^{0}\pi^+$. We use a high statistics data sample collected with the BaBar detector at the PEP-II asymmetric $e^+e^-$ collider at SLAC.

Search for Associated Production of Z and Higgs Bosons in nu nu bb Final States. We present a preliminary result of the search for the decay $D^0 \rightarrow \omega \eta$ where $D^0$ comes from the decay $D^{*+} \rightarrow D^{0}\pi^+$. We use a high statistics data sample collected with the BaBar detector at the PEP-II asymmetric $e^+e^-$ collider at SLAC.

Search for Associated Production of Z and Higgs Bosons in nu nu bb Final States. We present a preliminary result of the search for the decay $D^0 \rightarrow \omega \eta$ where $D^0$ comes from the decay $D^{*+} \rightarrow D^{0}\pi^+$. We use a high statistics data sample collected with the BaBar detector at the PEP-II asymmetric $e^+e^-$ collider at SLAC.
Elementary than quarks, and also undetectable, until it hadronizes. The primeval properties of such most elementary particles will be postulated.

Nuclear fragments, while a huge amount of kinetic energy is converted to matter. The primitive matter and gluons radiate from the fireball. This matter may be more quarks may take place during the first phase of the relativistic collision of gold ions. For a very short time components of the ions may be broken into tiny quarks as a material phase in equilibrium with another internal phase (gluons?). Deconfining a quark from its environment would destroy it. Destruction of asymptotic freedom. The theories predicted the production of a deconfined gaseous plasma. A perfect liquid was obtained instead. It is possible to consider first principles calculations are difficult. It is thus important to try to extract the viscosity from experimental data. Viscous hydrodynamics provides a tool that can attack this problem and which may work in regions where ideal hydrodynamics fails. Using the 2nd order Israel-Stewart formulation of (2+1) dimensional viscous hydrodynamics, we numerically study the effects from shear viscosity on the hydrodynamics evolution of a QGP, the final hadron spectra, and their elliptical flow coefficient $v_2$, for Cu+Cu collisions at RHIC. It turns out that the elliptic flow $v_2$ is very sensitive to the QGP shear viscosity, and that even the lowest bound, derived from AdS/CFT conjecture, $\eta/s = 1/4\pi$, leads to a large suppression of $v_2$. We also explore the scaling behavior of $v_2$ with the initial source eccentricity $\varepsilon_s$, by computing $v_2/\varepsilon_s$ as a function of charged hadron multiplicity in both ideal hydrodynamics and viscous hydrodynamics, comparing Cu+Cu and Au+Au collisions at a variety of impact parameters and collision energies.

Elliptic Flow and HBT radii of thermal photons from ideal hydrodynamics, EVAN FRODERMANN, The Ohio State University — Ideal hydrodynamics has been successful in describing many characteristics of the fireball created in a heavy ion collision. Through studying the elliptic flow ($v_2$) of thermally emitted particles and the corresponding Hanbury-Brown Twiss (HBT) radii, we obtain a picture of both the dynamics and geometry of a collision. Typically $v_2$ and HBT radii are calculated for abundant particles such as charged pions which decouple from the thermal medium at later times. Photons, however, decouple from the medium when they are created, particularly from the early hot QGP stage. We explore the photon elliptic flow and HBT radii for noncentral Au+Au collisions using an ideal hydrodynamical model to describe the collision. We predict a strong $p_T$ dependence of the photon elliptical flow as compared to hadronic flow from hydrodynamics. We also present our first results of photon HBT radii from ideal hydrodynamics, in particular the azimuthal oscillations of the HBT radii.

Causal Viscous Hydrodynamics in 2+1 Dimensions, HIUICHAO SONG, Department of Physics, The Ohio State University, Columbus, OH 43210, USA, ULRICH HEINZ, Department of Physics, The Ohio State University, Columbus, OH 43210, USA, CERN, Physics Department; Theory Division, CH-1211 Geneva 23, Switzerland — The viscosity of the QGP is a hotly debated theoretical subject, and first principles calculations are difficult. It is thus important to try to extract the viscosity from experimental data. Viscous hydrodynamics provides a tool that can attack this problem and which may work in regions where ideal hydrodynamics fails. Using the 2nd order Israel-Stewart formulation of (2+1) dimensional viscous hydrodynamics, we numerically study the effects from shear viscosity on the hydrodynamics evolution of a QGP, the final hadron spectra, and their elliptical flow coefficient $v_2$, for Cu+Cu collisions at RHIC. It turns out that the elliptic flow $v_2$ is very sensitive to the QGP shear viscosity, and that even the lowest bound, derived from AdS/CFT conjecture, $\eta/s = 1/4\pi$, leads to a large suppression of $v_2$. We also explore the scaling behavior of $v_2$ with the initial source eccentricity $\varepsilon_s$, by computing $v_2/\varepsilon_s$ as a function of charged hadron multiplicity in both ideal hydrodynamics and viscous hydrodynamics, comparing Cu+Cu and Au+Au collisions at a variety of impact parameters and collision energies.

Elliptic Flow and HBT radii of thermal photons from ideal hydrodynamics, EVAN FRODERMANN, The Ohio State University — Ideal hydrodynamics has been successful in describing many characteristics of the fireball created in a heavy ion collision. Through studying the elliptic flow ($v_2$) of thermally emitted particles and the corresponding Hanbury-Brown Twiss (HBT) radii, we obtain a picture of both the dynamics and geometry of a collision. Typically $v_2$ and HBT radii are calculated for abundant particles such as charged pions which decouple from the thermal medium at later times. Photons, however, decouple from the medium when they are created, particularly from the early hot QGP stage. We explore the photon elliptic flow and HBT radii for noncentral Au+Au collisions using an ideal hydrodynamical model to describe the collision. We predict a strong $p_T$ dependence of the photon elliptical flow as compared to hadronic flow from hydrodynamics. We also present our first results of photon HBT radii from ideal hydrodynamics, in particular the azimuthal oscillations of the HBT radii.
Limitations as well as other theories. Fully differential cross sections calculated using the FBA and 4DW models will be compared to absolute experimental results, as the two outgoing electrons. The more sophisticated four-body distorted wave (4DW) model treats all continuum particles as distorted waves and explicitly includes the post collision Coulomb interaction between the two final state continuum electrons. The first Born approximation (FBA) treats the projectile as a plane wave, and ignores the post collision Coulomb interaction between the two atomic bound states. Two theoretical models will be discussed for several possible outcomes of this type of collision. The first Born approximation (FBA) and renormalization scale as well as through the calculated nuclear properties resulting from these interactions [4]. A selection of these comparisons will be presented.


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Work supported in part by NSF grant PHY-0457219

Cluster separability and currents in the Poincaré invariant three-nucleon problem, MARK TUCKER, University of Iowa, BRADLEY KEISTER, NSF, WAYNE POLYZOU, University of Iowa — We examine the quantitative implication of the requirement of cluster separability in Poincaré-invariant formulations of the quantum mechanical three-body problem. One can formulate the problem using two-body interactions in a representation that satisfies Poincaré invariance, but which violates cluster separability. An additional non-trivial unitary transformation restores cluster properties. This unitary transformation is needed for a consistent computation of matrix elements of currents that have cluster expansions in systems of three particles or more, as well as bound state properties of four particles or more. We exhibit the nature and size of these effects in a model form factor of a three-body system consisting of a nucleon in the presence of a spectator deuteron using the calculation of current matrix elements with and without these unitary transformations.

This work supported in part by U.S. D.O.E. contract No. DE-FG02-86ER40286

A realistic three-nucleon interaction in the $^4$He scattering system, JOHANNES KIRSCHER, HARALD GRIESSHAMMER. The George Washington University — Using the framework of the refined resonating group (RRGM) variational technique we investigate the $J^P = 0^+$ partial wave of the $^4$He scattering system for an adjusted version of the realistic Illinois potential model (IL) which was devised as an extension of the Urbana IX (UIX) model. We compare the results to an R-matrix analysis and an RRGM calculation for the UIX potential. The binding energy, $S$-, $P$-, $D$-state probabilities, the average charge- and mass radii of the $^4$He bound state are given as well. We find all results consistent with the UIX ones and note only a difference in the $t$-p and $^4$He-$n$ phase shifts in the region of the $T = 0$ resonance.

The grant of computing time at the RRZE is gratefully acknowledged.

first author’s thesis adviser

ABSTRACT WITHDRAWN

Theoretical Fully Differential Cross Sections for Four-Body Processes, A.L. HARRIS, J.L. PEAChER, M. SCHULZ, D.H. MADISON, Missouri University of Science and Technology — Atomic collisions present a valuable opportunity to study the few-body problem. Advances on the theoretical side now allow for an essentially exact numerical calculation of one of the simplest the few-body problems - the three-body problem. However, study of the four-body problem is still in its infancy, and the agreement between experiment and theory for kinematically complete experiments is far from satistactory. The simplest four-body problem is a charged particle collision with helium in which both atomic electrons change state. Two theoretical models will be discussed for several possible outcomes of this type of collision. The first Born approximation (FBA) treats the projectile as a plane wave, and ignores the post collision Coulomb intereaction between the two final state continuum electrons. The more sophisticated four-body distorted wave (4DW) model treats all continuum particles as distorted waves and explicitly includes the post collision Coulomb interaction between the two outgoing particles. Fully differential cross sections calculated using the FBA and 4DW models will be compared to absolute experimental results, as well as other theories.
2:54PM L14.00008 Solving Schrodinger Equation in Mixed Representation. MALLIKA DHAR, CHARLES WERNETH, The University of Southern Mississippi, CHRISTOPHER SIROLA, KHIN MAUNG, The University of Southern Mississippi, USM COLLABORATION — Solving the Schrödinger equation with relativistic kinematics is easier in momentum space since the momentum operators under the radical sign simply become numbers. But power law potentials become singular in momentum space and subtraction procedures become necessary. By using the coordinate representation for the potential part and momentum representation for the kinetic energy part, one can solve these problems, but the resulting equation has an oscillating integral with a constant rotational velocity. We expand the wave function in a complete set of basis functions which has an exact Fourier transform and study the convergence of the solution by using different integration methods.

3:06PM L14.00009 Physical Properties of Human Whole Salivary Mucin:A Dynamic Light Scattering Study. MANISH MAHAJAN, All India Institute of Medical Sciences, New Delhi. VIJAY KUMAR, MAYANK SARASWAT, SVAVITA YADAV, N.K. SHUKLA, T.P. SINGH, DR. BHIM RAO AMBEDHAKAR INSTITUTE OF ROTARY CANCER HOSPITAL COLLABORATION — Human salivary mucin, a primary mucous membrane coating glycoprotein forms the first line of defense against adverse environments, attributed to the complex formation between mucin subunits and non mucin species. Aim of the study was to emphasize the effect of pH, denaturants (guanidinium hydrochloride, urea) and detergents (CHAPS, TRITON X -100, SDS on human whole salivary mucin. Hydrodynamic size distribution was measured using DLS. It was observed that aggregation was due to increase in hydrophobic interactions, believed to be accomplished by unfolding of the protein core. Whereas, the detergents which solubilize the proteins by decreasing hydrophobicity lead to disaggregation of mucin into smaller fragments. Mucin subjected to tobacco extract and upon subsequent addition of nicotine was found to have a disaggregating effect on it, suggesting nicotine may be one of the factors responsible for the disaggregating effect of tobacco on mucin, an important carcinogenic mechanism.

Sunday, April 13, 2008 1:30PM - 2:42PM – Session L15 DPF DAP: New Ideas in Cosmology Hyatt Regency St. Louis Riverfront (formerly Adam039,s Mark Hotel), St. Louis H

1:30PM L15.00001 A Potential Link Between the Cosmological Constant and the Fine-structure Constant. SHANTILAL GORADIA, Gravity Research Institute — The age of the universe, about 10¹⁰⁰ Planck times, makes the spherical radius (R) of its space 10⁶⁰ Planck lengths, as the light moves one Planck length per one Planck time. The fine-structure constant (α) closely equals the natural logarithm of the square root of the reciprocal of the cosmological constant (Λ), making α ≈ ln √(1/Λ), where λ = 1/R² as originally introduced by Einstein in equation number (14) in his 1917 paper: Cosmological Considerations on the General Theory of Relativity. This confirms the time-dependent variation of fine-structure constant in [1], but does not address the issue of dark energy. While [1] invokes negative entropy (-Q/T), so it also invokes dark energy simply. The problem still remains that no theory, as yet, combines the probabilistic aspect of quantum mechanics with gravity. In the meanwhile, we can link [1] with the quantum information theory as information links to entropy. [1] Goradia S. Preprint at (http://www.arxiv.org/physics/0210040 v3 (Jan 2007).

1:42PM L15.00002 The Calculated Value of the Fine Structure Constant From Gravitational Potential. D.T. FROEDGE, Formerly Auburn University — In previous presented papers, we have postulated a relation between the gravitational potential and the Fine Structure Constant, (Alpha) necessary for the validity of those papers. In this paper will explore the absolute magnitude of Alpha in regard to the cosmological induced potential generated by the total mass in the system. Although the value of the Fine Structure Constant is known to a very high precision, current QM and GR do not offer an explanation for the value, and it must be determined experimentally. Extremely precise relations between Alpha and the Gyromagnetic ratio make this possible. (7pbp) This paper offers an explanation of, and calculates the value, within the error bars, of current experimental data. Since there is a temporal variability predicted in alpha, and because of the current precision of measurements of Alpha, a test of the change predicted by this conjecture is possible. http://www.arxvid.org/css/alpha.pdf

1:54PM L15.00003 Cosmic Observations and Speculation. SOL AISENBERG, IT GROUP — Newton’s laws of gravity, based upon solar system observations are assumed to also apply in the universe, and has needed the belief in Dark Matter to explain the observations of Rubin for spiral galaxies, and of Zwicky for groups of galaxies. For mass M and Newton’s gravitational constant Gn, star motion in spiral galaxies is described by M*Gn*A*r. Observed constant rotational velocities v. results in the product M*Gn as a linear function of distance r. Current speculation is that M provides the linear dependence and results in belief in massless Dark Matter. Our alternate Theory of Additional Gravity, (TAG), adds this linear term to Newton’s gravitational constant as Ga=Gn-A*r. This explains observations outside our solar system. This new TAG theory for gravity involves distances and is different from the MOND theory of Milgrom, which involves acceleration. Also, about seven decades ago, Hubble observed remote galaxies and found a linear relationship between the distances and red shifts. Belief is that the red shift is “apparently” due to the Doppler effect. Velocities were not directly measured. This belief led to the apparent expanding universe, and Dark Energy. We explain red shift by three forms of gravity including gravitational drag on interstellar dust and gas.

2:06PM L15.00004 The Dual-Time Physics of the Universe. PAUL SUH, EWSF Group — Novel physics founded on a dual and commensurate space-time universe explicates the nature of dark matter and energy [see APS 2007 Spring Meeting]. Its governing principles also illuminate the dark matter and energy become unobservable, why the dark energy still suffuses the universe while the observable energy had long faded into the cosmic microwave background, how the black hole singularity is circumvented, why the supernovae shone brighter eight billion years ago, what energy had powered the big-bang inflationary expansion, how the expansion of the universe began to accelerate about five billion years ago, and other formidable cosmological puzzles. This paper is available on request to pksuh@msn.com.

2:18PM L15.00005 Redefining Planck Mass: Unlocking the Fundamental Quantum of the Universe. JOHN LAUBENSTEIN, IWPD Research Center — The large value of the Planck Mass relative to the quantum scale raises unanswered questions as to the source of mass itself. While we wait for experimental verification of the elusive Higgs boson, it may be worth recognizing that Planck Mass is not the result of rigorous mathematics – but rather derived from an intuitive manipulation of physical constants. Recent findings reported by IWPD suggest a quantum scale Planck Mass as small as 10 -(-73) kg. At this scale, the Planck Mass joins Planck Length and Time as a truly fundamental quantum entity. This presentation will provide evidence supporting the fundamental quantum nature of a dramatically smaller Planck Mass while discussing the impact of this finding on both the quantum and cosmic scale. A quantum scale Planck Mass will require an accelerating expansion of the universe at an age of 14.2 billion years. No initial conditions are imposed at the earliest Planck Time of 10 (44) s allowing the universe to evolve as a background free field propagating at the speed of light with a local degree of freedom. This model provides the basis for a quantum theory of gravity and provides a conceptual pathway for the unification of GR and QM.
K1.00001 PHYSICS EDUCATION POSTERS —

K1.00002 Overview of the Howard University Interdisciplinary Science for Middle Schools (ISMS) Program

MARCUS ALFRED, Department of Physics and Astronomy, Howard University — The goals of the ISMS program are to expose science graduate students (fellows), middle school teachers, and middle school students to new perspectives and skills in STEM fields, and to create new opportunities in STEM fields for all participants. The fellows and middle school teachers in the program create and use science activities and curriculum modules for physical science, life science and environmental science middle school classes.

Support provided by the National Science Foundation Graduate K-12 Program

K1.00003 ABSTRACT WITHDRAWN —

K1.00004 Disentangling the Force Concept Inventory Using Latent Class Analysis

HELENA DEDIC, STEVEN ROSENFIELD, Vanier College — This study probes dimensionality of the Force Concept Inventory (FCI) using a latent class factor analysis of data collected at three universities (6621 records). The best fitting 5-factor model closely matches theoretical groupings of items envisioned by the FCI authors. Although this model accounts for more than 95% of bivariate associations present in the data, and the p-value indicates the model is acceptable, there remain some unexplained pair-wise associations between items. This result shows that the FCI measures several abilities rather than just one. Thus, assigning separate scores to each factor may be more appropriate than the total score of correct answers. This is especially important for physics educational researchers who use the FCI to assess the effectiveness of particular pedagogies. When the scores are reported for individual records, the changes in each of the latent abilities with instruction may be rigorously measured. We have found that the pre-instruction and post-instruction scores for all three universities showed significant gains for three of the factors (understanding of Newton’s 3rd Law, Cancelling forces/Constant forces and Gravitation). The gains in the other two factors were not statistically significant because they were below the classification error.

K1.00005 Summer Institute for High School Teachers

PONN MAHESWARANATHAN, CLIFF CALLOWAY, Winthrop University — We have conducted again a summer institute for high-school teachers in South Carolina at Winthrop University. The target audience were 9th grade physical science teachers in schools within a 50-mile radius from Winthrop. We developed a graduate level physics professional development course covering selected topics from the physics and chemistry content areas of the South Carolina Science Standards. Delivery of the material included the traditional lectures and the following innovative approaches in science teaching: hands-on experiments, group activities, computer based data collection, group discussions, and presentations. Two master teachers assisted us during the delivery of the course which took place in June 20-29, 2007 using Winthrop facilities. Requested funds were used for the following: salary for us and master teachers, contract course fee, some of the participants’ room and board, startup equipment for all the teachers, and indirect costs to Winthrop University. Startup equipment included Pasco’s stand-alone and portable Xplorer GLX interface and sensors (temperature, voltage, pH, pressure, motion, and sound). What we learned and ideas for continued K-12 teacher preparation initiatives will be presented.

1Supported by a grant from the South Carolina Department of Education

K1.00006 Investigating the Conceptual Variation of Major Physics Textbooks

JOHN STEWART, RICHARD CAMPBELL, University of Arkansas, JESSICA CLANTON, Arkansas Tech - Mountain Home — The conceptual problem content of the electricity and magnetism chapters of seven major physics textbooks was investigated. The textbooks presented a total of 1600 conceptual electricity and magnetism problems. The solution to each problem was decomposed into its fundamental reasoning steps. These fundamental steps are, then, used to quantify the distribution of conceptual content among the set of topics common to the texts. The variation of the distribution of conceptual coverage within each text is studied. The variation between the major groupings of the textbooks (conceptual, algebra-based, and calculus-based) is also studied. A measure of the conceptual complexity of the problems in each text is presented.

1This research supported in part by NSF Grant DUE-0535928.

K1.00007 Characterizing the Evolution and Variation of Major Physics Textbooks

JENNIFER CAMPBELL, JOHN STEWART, University of Arkansas — The linguistic and structural properties of two major physics textbooks are compared. The structure of each textbook is measured and differences in the amount of space, words, and mathematics devoted to different parts of the text are reported. The linguistic richness of each text and each textual part is measured using LEXX. The readability of each textbook is characterized using standard readability formulas. A new readability formula that corrects for mathematics is proposed. The evolution of one of the textbooks over a fifteen year (four versions of the text) time span is also investigated. The reading difficulty of the textbook increased by approximately one-half a grade level over fifteen years. The lexical richness of the textbook also increased over the same period.
Quantum Mechanics: The resulting model of light will be tested by numerical simulation of a photon behaving in a wave-like manner such as diffusion, interference, reflection, and speculations are combined with the cosmological scalar potential model (SPM). The SPM was tested by confrontation with observations of galaxy HI rotation. The high uncertainty in G is commonly attributed to the weakness of gravity and the impossibility of shielding it. But this does not satisfy: excellent groups have measured G with well controlled, precise methods. Yet their results disagree, suggesting some unknown, uncontrolled factor is in play. What could that factor be? In a separate paper at this conference, Donovan demonstrates that cosmological Dark Energy follows from a yet-unnoticed consequence of quantum mechanics and the age of the universe. His Dark Energy field has known characteristics, allowing calculation of its gradient and the force it exerts. This talk factor be? In a separate paper at this conference, Donovan demonstrates that cosmological Dark Energy follows from a yet-unnoticed consequence of quantum mechanics and the age of the universe. His Dark Energy field has known characteristics, allowing calculation of its gradient and the force it exerts. This talk describes a semi-classical approach to derive the equation describing the effective force that results from this energy. Like Newtonian gravity, the resulting force is proportional to mass but decreases as 1/r, not 1/r^2. This uncontrolled factor has a magnitude large enough to affect measurements of G in laboratory experiments with the size of the error depending upon the details of the apparatus. When this effect is estimated and subtracted from reported precise values of G, it accounts for most of the variation between measurements made by different groups.

Stellar and dark matter caustics: are both visible? ROBYN SANDERSON, MIT — Dark matter caustics formed by galaxy mergers can substantially enhance the local density of dark matter, and even more substantially enhance the gamma-ray flux from WIMP annihilations in those caustics, in some cases by several orders of magnitude. This effect raises the possibility that a high-energy gamma ray detector, such as GLAST, may be able to detect annihilation signals from extragalactic caustics. I calculate the annihilation flux for two cases where caustics are already known to exist from stellar morphology and kinematics: the classic shell galaxy NGC3293 and the shell in the Andromeda galaxy (M31) recently discovered by Fardal et al.

Characterizing the Effect of Written Presentation on Performance in an Introductory Physics Class SHAWN BALLARD, JOHN STEWART, University of Arkansas — Samples of student writing on hourly exams in an introductory science class were characterized based on important presentation features such as the number of words, sentences, mathematical expressions, and graphs. Correlation analysis is used to determine the features of student writing that most directly affect student performance in the class and student conceptual mastery of the material. Regression analysis shows that written presentation data can be used to predict student exam performance with R-squared=0.38. Student writing behavior also allows the prediction of conceptual performance with R-squared=0.20. Substantially stronger predictive power for both exam performance and conceptual mastery is obtained if time-on-task data is combined with written presentation data.

TESTS OF PHYSICAL LAWS POSTERS

Stellar and dark matter caustics: are both visible? ROBYN SANDERSON, MIT — Dark matter caustics formed by galaxy mergers can substantially enhance the local density of dark matter, and even more substantially enhance the gamma-ray flux from WIMP annihilations in those caustics, in some cases by several orders of magnitude. This effect raises the possibility that a high-energy gamma ray detector, such as GLAST, may be able to detect annihilation signals from extragalactic caustics. I calculate the annihilation flux for two cases where caustics are already known to exist from stellar morphology and kinematics: the classic shell galaxy NGC3293 and the shell in the Andromeda galaxy (M31) recently discovered by Fardal et al.

Dark Energy and Measurements of Newton’s Constant, G JAMES DONOVAN, Shimer College — The high uncertainty in G is commonly attributed to the weakness of gravity and the impossibility of shielding it. But this does not satisfy: excellent groups have measured G with well controlled, precise methods. Yet their results disagree, suggesting some unknown, uncontrolled factor is in play. What could that factor be? In a separate paper at this conference, Donovan demonstrates that cosmological Dark Energy follows from a yet-unnoticed consequence of quantum mechanics and the age of the universe. His Dark Energy field has known characteristics, allowing calculation of its gradient and the force it exerts. This talk describes a semi-classical approach to derive the equation describing the effective force that results from this energy. Like Newtonian gravity, the resulting force is proportional to mass but decreases as 1/r, not 1/r^2. This uncontrolled factor has a magnitude large enough to affect measurements of G in laboratory experiments with the size of the error depending upon the details of the apparatus. When this effect is estimated and subtracted from reported precise values of G, it accounts for most of the variation between measurements made by different groups.

Scalar Potential Model of light JOHN HODGE, Blue Ridge College — Some observations of light are inconsistent with a wave-like model. Other observations of light are inconsistent with a particle-like model. A model of light is proposed wherein Newton’s and Democritus’s speculations are combined with the cosmological scalar potential model (SPM). The SPM was tested by confrontation with observations of galaxy HI rotation curves (RCs), asymmetric RCs, redshift, discrete redshift, galaxy central mass, and central velocity dispersion; and with observations of the Pioneer Anomaly. The resulting model of light will be tested by numerical simulation of a photon behaving in a wave-like manner such as diffusion, interference, reflection, spectral characteristics, and an Asher experiment. Although the SPM light model requires more work, early results are beginning to emerge that suggest possible tests because a few predictions are inconsistent with both the current particle and wave models of light and that suggest a re-interpretation of the equations of quantum mechanics.

The influence of the local volume fluctuations on the equation-of-state of hot and dense plasmas DAVID SALZMANN, Department of Particle Physics, Weizmann Institute of Science, Rehovot, Israel, DIMA FISHER, Department of Neurobiology, Weizmann Institute of Science, Rehovot, Israel, AVRAHAM BARSHALOM, NRCN, P.O.Box 9001, Israel, JOSEPH OREG, Argel Inc. Ellicott City MD 21042, USA — Generally, equation-of-state (EOS) of hot and dense plasmas is computed under the assumption that there is a constant volume available to every ion/atom in the plasma. In the present paper we combined two recently developed models to evaluate the influence of local density fluctuations around the ions on the corresponding EOS. The first of these is the so-called Ion Ellipsoid Model (IEM). IEM assumes that the local volume of the ion is a 3-dimensional ellipsoidal enclosure. Full description of the model is given in Ref. [1]. From IEM semi-empirical formulas were derived for the ions volume distribution function [1] for 0<1<16, where 1 is the plasma coupling constant. The EOS was computed by means of the EOSTA model [2], that combines and extends the STA and INFERNO models to calculate opacities and EOS on the same footing. We will describe the model and present preliminary results indicating the effect of the volume fluctuations around the ions on EOS results.

Structural Phases in Complex Plasmas TRUELL HYDE, JIE KONG, LORIN MATTHEWS, JORGE CARMONAREYES, CASPER - Baylor University — Dust particles imbedded within a plasma acquire a charge from collisions with free electrons and ions in the plasma. If the ratio of the inter-particle potential energy to the average kinetic energy is sufficient, the particles exhibit short to long range ordering. Interestingly, dust particles under these conditions often form vertical chains due to the influence of the wakefield produced by the streaming ions in the plasma sheath. Such particle chains are proving to be a unique diagnostic tool for investigating the physics behind the basic properties of the system. This paper will discuss recent experimental results illustrating various aspects of this phenomenon.
K1.00018 Theory of the Motion of Ball Lightning. PETER HANDELM, Univ. of MO St Louis Physics & Astron. Dept —

The Maser-Soliton Theory of BL predicts the dynamics of each of the harmonic waves in the wave packet that feeds and in fact defines the Langmuir plasma soliton that is observed as BL. The frequencies in the wave packet are in a narrow window f that corresponds in the case of open air BL to the diameter of the area in which the damage caused by the final explosion of the BL is observed. This is usually of the order of \( \frac{1}{2} \) m roughly, in rms. The corresponding wave vector interval is \( \Delta k = (1/2)(1/30m) \approx 0.017/m \) in rms. At the same time, k is of the order of 6/m, yielding \( k/\Delta k = 360 \). This pronounced line-narrowing is obtained due to the large gain of the atmospheric maser when it generates the Kapitsa standing wave. Phase differences between the waves that make up the electromagnetic field that couples with the electrostatic field of the soliton are determined by the frequency dependence of gain and dissipation. They are influenced less by the motion of the air, than by the maser dynamics and by the boundary conditions shaping the electromagnetic field, i.e. the individual photonic wave-packet. The paper presents the equations that determine the phase dynamics and therefore also the observed motion of BL. A similar phase dynamics is expected to be applicable to the special case of UFO motions.

K1.00019 Nonlinear interactions, and turbulence associated with large amplitude Alfvén waves in a laboratory plasma1. TROY CARTER, DAVID AUERBACH, Dept of Physics and Astronomy, UCLA — From a weak turbulence point of view, nonlinear interactions between shear Alfvén waves are fundamental to the turbulent energy cascade in magnetic turbulence. Motivated by this, experiments on the interaction between large amplitude Alfvén waves are being carried out on the Large Plasma Device (LPD) at UCLA. Large amplitude Alfvén waves (\( \Delta B/B \sim 1\% \)) are generated either using a resonant cavity (the Alfvén wave Maser) or loop antennas. Nonlinear interactions between two copropagating kinetic Alfvén waves have been observed. Strong, localized electron heating during large amplitude kinetic Alfvén wave launch is also observed. The heating results in significant gradients in the electron temperature which in turn excite unstable drift-Alfvén waves. The drift waves then interact with the initial Alfvén wave, leading to sidebands and spectral broadening. Details of these experimental observations will be discussed, as well as future plans for studies of nonlinear processes associated with Alfvén waves in LPD.

K1.00020 A Simple Ion-Ion Charge Exchange Model for Kinetic Plasma Simulations. DAVID FILLMORE, PETER MESSMER, PAUL MULLOWNEY, Tech-X Corporation — We present a simple modification of the semi-classical over-barrier model of ion-atom charge exchange for the case of electron transfer between positive ions. The charge exchange cross-sections have been incorporated into an electromagnetic particle-in-cell plasma model which also includes schemes for electron impact ionization and electron-ion recombination. The influence of charge exchange on the plasma ionization state is explored for selected light elements under various temperature and density regimes.

K1.00021 Generation of supersonic plasma jets from pulsed-power driven exploding wire experiments1. SIMON BOTT, DAVID HAAS, YOSSOF ESHAQ, UTAKO UEDA, ROBERT MADDEN, GILBERT COLLINS, FARHAT BEG, University of California, San Diego, CENTER FOR ENERGY RESEARCH, UNIVERSITY OF CALIFORNIA, SAN DIEGO TEAM — Astrophysical jets and supersonic outflows are associated with a wide range of phenomena. Determination of the processes which dominate jet behaviour can be used to infer the properties of their sources which include Young Stellar Objects (YSO) and Active Galactic Nuclei (AGN). Limited observational data makes the construction of theoretical descriptions based on laboratory experiments important. We present an experimental study of the generation of plasma jets in exploding wire experiments for both \( x \)-pinch and conical configurations. These will be examined at 80 kA and 250 kA and diagnosed by laser interferometry and time-resolved self emission to infer the electron density and temperature range respectively. Estimations of the dimensionless parameters (Mach number, jet/ambient density ratio, cooling parameter) will be given for each experiment. Future studies and scaling of experiments to larger currents will be discussed.

K1.00022 Evidence for an intense solar outburst in prehistory. A.L. PERATT, Los Alamos National Laboratory, W.F. YAO, Albuquerque Public Schools System — A past intense solar outburst and its effect on Earth was proposed by Gold [3] who based his hypotheses on astronomical and geophysical evidence. The discovery that objects from Neolithic or Early Bronze Ages carry patterns of high-current Z-pinches provides insight into the origin and meaning of these ancient symbols produced by mankind. A comparison of graphical and radiation data from high-current Z-pinches to petroglyphs and megaliths is made [1]. These correspond to mankind’s visual observations of ancient aurora if the solar wind had increased at times between one and two orders of magnitude, millennia ago [3]. Reference [2] focused on the source of light and its temporal change from a current-increasing Z-Pinch to petroglyphs and megaliths. These correspond to mankind’s visual observations of ancient aurora if the solar wind had increased at times between one and two orders of magnitude, millennia ago [3]. References [1, 2] focused on the source of light and its temporal change from a current-increasing Z-Pinch to petroglyphs and megaliths. These correspond to mankind’s visual observations of ancient aurora if the solar wind had increased at times between one and two orders of magnitude, millennia ago [3].

K1.00023 The Case for Enhanced Transport Coefficients in Astrophysical Plasmas. STEVEN SPANGLER, University of Iowa — Theoretical descriptions of astrophysical plasmas such as the solar corona, the interstellar medium, and extragalactic radio sources typically employ single fluid magnetohydrodynamics (MHD). The lack of detail in astronomical observations often disqualifies more sophisticated theories. Solutions of the MHD equations can possess agreement with observations, but only if transport coefficients such as resistivity, viscosity, and thermal conductivity are many orders of magnitude larger than independent estimates based on binary electron collisions with ions and electrons. Illustrations of this concept are Joule heating of the solar corona by observed currents and the structure of the magnetic field in the Milky Way and similar galaxies. This situation can be understood in one of two ways. (1) The MHD equations may indeed be a correct description of the dynamics of these plasmas, and the true transport coefficients are greatly enhanced over collisional values. (2) Alternatively, more complex sets of primitive equations may be needed to describe astrophysical plasmas. This paper explores possibility (1), and discusses possible mechanisms for transport coefficient enhancement, and observational tests of those mechanisms.

1 Supported by NSF CAREER Award PHY-0547752 and DOE Fusion Science Center Cooperative Agreement DE-FC02-04ER54785.

1 Work is partially supported by DOE Junior Faculty Grant DE-FG02-05ER54842

1 This work is supported by the National Science Foundation through grant ATM03-54782
K1.00024 Experimental study of plasma bubble expansion as a model for extragalactic radio lobes

SCOTT HSIU, LANL, ALAN G. LYNN, YUE ZHANG, UNM, WEI LIU, HUI LI, LANL, CHRISTOPHER WATTS, MARK GILMORE, UNM — Recent work in plasma astrophysics has suggested that magnetic energy features prominently in the large-scale evolution of active galaxies. The Plasma Bubble Expansion Experiment (PBEX) at UNM will conduct laboratory experiments to address outstanding nonlinear plasma physics issues related to how magnetic energy and helicity carried by extra-galactic jets interacts with the intergalactic medium to form extra-galactic radio lobe structures. A newly-built pulsed coaxial gun will form and inject magnetized plasma bubbles into a lower pressure weakly-magnetized background plasma formed by the helicon and/or hot cathode source in HELCAT, a 4 m long and 50 cm diameter linear plasma device. Plasma properties can be adjusted such that important dimensionless parameters are relevant to the astrophysical context. Ideal MHD simulations of the experiment have indicated the strong possibility of MHD shocks appearing. This poster will provide an overview of the physics goals, experimental design/status, and coordinated theory/modeling of PBEX.

1Supported by NSF/DOE and LANL-LDRD.

K1.00025 Ideal Magnetohydrodynamical Simulations of Magnetic Bubble Expansion as a model for extragalactic radio lobes

WEI LIU, SCOTT HSIU, HUI LI, SHENGTAI LI, LANL, ALLAN LYNN, University of New Mexico — Recent astronomical observations indicate that radio lobes are gigantic relaxed magnetized plasmas with kilo-to-megaparsec scale jets providing a source of magnetic energy from the galaxy to the lobes. Therefore we are conducting a laboratory plasma experiment, the Plasma Bubble Expansion Experiment (PBEX) in which a higher pressure magnetized plasma bubble (i.e., the lobe) is injected into a lower pressure background plasma (i.e., the intergalactic medium) to study key nonlinear plasma physics issues. Here we present detailed ideal magnetohydrodynamic (MHD) three-dimensional simulations of PBEX. Given reasonably low injection speeds of the magnetic bubble, its expansion due to the Lorentz force leads to one perpendicular MHD shock and one compressible reversal MHD wavefront, where three-dimensional reconnection results due to numerical resistivity. With the expansion, some angular momentum is transported from the rotating magnetic bubble to the background plasma mainly due to advection. The discovery of MHD shocks in the simulations shows that PBEX provides a rare opportunity to study MHD shocks in a laboratory experiment. Comparison of models and measurements will be used to validate the theoretical tools, which we will apply to nonlinear relaxation of magnetized plasmas in astrophysical systems.

K1.00026 Statistical Theory of a Magnetized Corona above a Turbulent Accretion Disk

DMITRI UZDENSKY, JEREMY GOODMAN, Princeton University — We present a statistical theory of a force-free magnetic field in the corona above a turbulent accretion disk. The field is represented by a statistical ensemble of loops tied to the disk. Each loop evolves under several physical processes: Keplerian shear, turbulent random walk of the disk footpoints, and reconnection with other loops. We introduce the distribution function of loops over their sizes and construct a kinetic equation that governs its evolution. This Loop Kinetic Equation is analogous to Boltzmann’s kinetic equation, with loop-loop reconnection described by a binary collision integral. A dimensionless parameter is introduced to scale the overall rate of reconnection relative to Keplerian shear. We solve the loop kinetic equation numerically to obtain the steady state distribution function and also calculate self-consistently the distribution of the mean magnetic pressure and dissipation rate with height, the equilibrium shapes of loops of different sizes, and the energy and torque associated with coronal magnetic loops. We explore the dependence of these quantities on the reconnection parameter.

1supported by NSF’s Center for Magnetic Self-Organization

K1.00027 3D relaxation of flux ropes: boundary conditions, bouncing, merging, onset of reconnection

T.P. INTRATOR, X. SUN, L. DORF, G. LAPENTA, Los Alamos National Laboratory — Magnetic fields in MHD plasmas also have corresponding image (ie source) currents. This situation can be represented with flux ropes, which are the building blocks of MHD plasmas. Examples that are 3D and not toroidal include in nature: Solar coronal loops, coronal holes, astrophysical jets; and in the laboratory: sphermaks, Z pinch, spacecraft thrusters, etc. For these situations, the axial boundary conditions are important. Using the Reconnection Scaling Experiment (RSX) we create an experimental laboratory model with 1, 2 or more linear flux ropes, with embedded current parallel to an external magnetic guide field. A current channel can relax via instability (e.g. kink), and we attempt to observe evidence of this. In the context of what line tying means. Multiple ropes mutually attract via strong, ideal MHD JxB forces. They are observed to bounce or coalesce (magnetically reconnect) on the speed of mutual approach. 3D relaxation occurs when flux ropes rotate about each other, while twist is transferred into writhe via the kink instability.

1Supported by U.S. DOE through the LANL/LDRD Program.

K1.00028 Hydrodynamic and atomic-kinetic modelling of photoionised neon plasmas

IAN HALL, TUNAY DURMAZ, ROBERTO MANCINI, University of Nevada, Reno, JIM BAILEY, GREGORY ROCHAU, Sandia Nat. Labs., MICHAEL ROSENBURG, DAVID COHEN, Swarthmore College, IGOR GOLOVKIN, JOSEPH MACFARLANE, Prism Comp. Sciences, MANOLO SHERRILL, JOSEPH ABDALLAH, LANL, ROBERT HEEETER, MARK FOORD, SIGFRIED GLENZER, LLNL — Photoionised plasmas are common in astrophysical environments. New high resolution spectra from such sources have been recorded in recent years by the Chandra and XMM-Newton satellites. These provide a wealth of spectroscopic information and have motivated recent efforts aimed at obtaining a detailed understanding of the atomic-kinetic and radiative characteristics of photoionised plasmas. The Z-pinch facility at the Sandia lab is the most powerful terrestrial source of X-rays and provides an opportunity to produce photoionised plasmas in a well characterised radiation environment. We present modelling work and experimental design considerations for a forthcoming experiment at Sandia in which X-rays from a collapsing Z-pinch will be used to photoionise low density neon contained in a gascell. View factor calculations were used to evaluate the radiation environment at the gascell; the hydrodynamic characteristics of the gascell were examined using the Helios-CR code, in particular looking at the heating, temperature and ionisation of the neon and the absorption of radiation. Emission and absorption spectra were also computed, giving estimates of spectra likely to be observed experimentally.

K1.00029 Opacity effects on the polarization of the chlorine He-alpha line

PETER HAKEL, ROBERTO MANCINI, University of Nevada, Reno — Polarization-based line spectroscopy is a valuable tool in determining the characteristics of the electron distribution in plasmas anisotropy is expected to be important. An example is the case of laser-produced plasmas driven by ultra-fast high-intensity pulsed lasers. Anisotropic electrons can unevenly populate magnetic sublevels of atomic energy levels resulting in partial polarization of the emitted spectral lines. Work done so far in this area has been performed in the optically-thin approximation, which typically is justified for satellite lines. However, recently this approach has been applied to resonance lines which can be optically thick under high-density conditions. Therefore we performed a modeling study of the He-alpha Cl line accounting for the effects of radiation transport on its polarization. This allows us to identify plasma regimes in which optically-thin approximation remains justified and those where opacity effects become important for this spectral line and the changes they introduce in the line polarization.
**K1.00030 Measurements of radiative shock properties using optical and scattering diagnostics**

A. VISCO, R.P. DRAKE, M.J. GROSSKOFF, Univ. of Michigan, D.H. FROULA, S.H. GLENZER, A.B. REIGHARD, Lawrence Livermore National Laboratory, T. BOEHLY, Univ. of Rochester, J.P. KNAUER, Univ. of Rochester — Radiative shocks are shock waves whose structure has been altered by radiation transport. Such shocks are present in numerous astrophysical systems, including supernova remnants, supernovae, and accretion disks. Recent experiments have used the Omega laser to study the shocked material in radiative shocks that are optically thin upstream and optically thick downstream. A thin slab of low-Z material is driven by a 1.1 atm. cylinder of high-Z gas at speeds over 100 km/s. producing strong radiative effects. Diagnostic techniques have included point projection radiography, Thomson scattering, and optical pyrometry, to make measurements of densities, temperatures, velocities, and the shocked layer structure.  

**K1.00031 Accessing the High Energy Density Regime using Plasma Jets**

JASON CASSIBRY, SETH THOMPSON, UAHuntsville — Plasma jets driven magnetoinertial fusion (PJMIF) is an emerging fusion energy concept which consists of an imploding liner which shock heats and compresses a magnetized target. The liner is formed by the merging of a cylindrical or spherical distribution of plasma jets, which are launched by a salvo of plasma accelerators. Confinement of the target is inertial, with the thermal conduction suppressed by the presence of the magnetic field. PJMIF is now being considered by the DOE as a path towards creating high energy density physics (HEDP) in the laboratory. In this paper, we will use analytical and numerical particle hydrodynamic (SPH) modeling to show how the HEDP regime is accessible by converging shock waves. The primary goal is to estimate the initial conditions required for plasma liners in reaching 1 Mbar pressure using imploding shocks. Our analytical models consist of the Noh test case and of a self-similar converging shock model in which radially imploding plasma shock heats and compresses a low density core to high pressures. Both models allow calculation of conditions behind a reflected shock in cylindrical or spherical geometry. We will use SPH to study carefully selected 2D and 3D cases based on the analytical study.

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**K1.00032 Specular Reflection of Intense Laser Light Interacting with Solid Targets**

A. LINK, D. OFFERMANN, V. OVCCHNIKOV, D. SCHUMACHER, L. VAN WOERKOM, R. R. FREEMAN, The Ohio State University, H. CHEN, D. HEY, I. JOVANOVIC, S. LE PAPE, A. MACKINNON, A. MACPHEE, P. PATEL, Y. PING, Lawrence Livermore National Laboratory, C. CHEN, Massachusetts Institute of Technology, T. BARTEL, S. CHAWLA, J. KING, T. MA, F. BEG, University of California, San Diego, K. AKLI, R. STEPHENS, General Atomics, Y. TSUI, University of Alberta — The reflectivity of high intensity laser plasma interactions is a crucial parameter in understanding laser coupling efficiency and light guiding properties of reentrant cones in fast ignition experiments. Studies of the specular reflectivity have been conducted on the Titan laser system in the Jupiter Laser Facility at Lawrence Livermore National Laboratory with solid density metal targets. Results from accurately calibrated scatter plates will be presented for intensities of $10^{15}$ to $10^{20}$ W/cm$^{-2}$, pulse widths from .7 to 10 ps, s and p polarizations and a variety of target geometries. Specular reflectivity of $s$ polarized light at $10^{20}$ cm$^{-2}$ increases by 4000% as the incident angle is varied from 28° to 75°.

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**K1.00033 Study of laser-created laboratory plasma jets with soft x-ray laser interferometry**

JONATHAN GRAVA, MICHAEL PURVIS, JORGE FILEVICH, MARIO MARCONI, JORGE ROCCA, Colorado State University, JAMES DUNN, STEPHEN MOON, Lawrence Livermore National Laboratory, VYACHESLAV SHLYAPTESEV, University of California Davis at Livermore, COLORADO STATE UNIVERSITY TEAM, LAWRENCE LIVERMORE NATIONAL LABORATORY COLLABORATION, UNIVERSITY OF CALIFORNIA DAVIS AT LIVERMORE COLLABORATION — Jet-like plasma structures were generated by irradiating V-shaped Al targets at $I=1 \times 10^{12}$ W/cm$^2$ with 0.8 J Ti:Sa laser pulses of 120 ps duration. A narrow plasma window was observed to expand from the bottom of the cavity with Mach number $\sim 5$. The plasma jet evolution was studied using soft x-ray laser interferometry ($\lambda = 46.9$ nm), allowing electron density measurements of the 1-mm plasma that exceeded $1 \times 10^{20}$ cm$^{-3}$. Late in the evolution the jet expands laterally and develops sidewaves as it interacts with additional material expanding from the walls. The measurements were compared with 2-D simulations from the code HYDRA to gain understanding of the mechanisms that form the narrow plasma jet, including the role of radiation cooling. Measurements of similar jets generated by irradiating targets of different Z are under way. Work sponsored by NN$^+$SA-SSA DOE Grant DE-FG52-06ER26152 and the U.S. DOE LNL through ILSA contract No. W-7405-Eng-48.

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**K1.00034 Laser-driven ultraintense proton beams for high energy-density physics**

SLAWOMIR JABLONSKI, JAN BADZIAK, PIOTR PARYS, MARCIN ROSINSKI, JERZY WOLOWSKI, Institute of Plasma Physics and Laser Microfusion, EURATOM Association, 00-908 Warsaw, Poland, ADAM SZYDLOWSKI, The Andrzej Soltan Institute for Nuclear Studies, Swierk, Poland, P. ANTICI, J. FUCHS, A. MANCIC, LULI, Ecole Polytechnique, CNRS, CEA, UPMC; Route de Saclay, 91128 Palaiseau, France — The results of studies of high-intensity proton beam generation from thin (1 – 3μm) solid targets irradiated by 0.35-ps laser pulse of energy up to 15J and intensity up to $2 \times 10^{19}$ W/cm$^2$ are reported. It is shown that the proton beams of multi-TW power and intensity above $10^{18}$ W/cm$^2$ at the source can be produced when the laser-target interaction conditions approach the Skin-Layer Ponderomotive Acceleration requirements. The laser-protons energy conversion efficiency and proton beam parameters remarkably depend on the target structure. In particular, using a double-layer Au/PS target (plastic covered by 0.1 – 0.2 μm gold) protected by aluminum on the back, the proton beam intensity than in the case of a plastic target. The values of proton beam intensities attained in our experiment are the highest among the ones measured so far.

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**K1.00035 Temperature gradient in a solid target produced by the deposition of energy by fast electrons generated in high Intensity Short Pulse Laser matter interactions**

SOPHIA CHEN, University of California, San Diego, PRAVESH PATEL, HYUN-KUNG CHUNG, ANDREAS KEMP, SEBASTIEN LE PAPE, BRIAN MADDOX, SCOTT WILKS, Lawrence Livermore National Laboratory, FARHAT BEG, University of California, San Diego — Recently systematic studies to investigate the temperature gradient in short-pulse laser irradiated solid targets. Experiments were conducted using the Titan Laser at the intensity $3 \times 10^{20}$ W/cm$^2$ (energy ~ 140 J with a pulse duration of 500 fs). The 2.4 micron thick targets were composed of 0.4 micron copper tamped by silver on the front and aluminum on the back. Depth of the copper layer was changed systematically to study heating due to fast electrons. Copper K-shell emission of 8 - 10 keV was measured with a Highly Oriented Pyrolytic Graphite (HOPG) spectrometer. Diagnostics also include a single-photon counting camera to provide absolute K-shell photon yield. Results show a significant drop in He-alpha emission within 0.75 mm from the front of the target, which indicates a rapid drop in temperature. Measurements are compared to Hydrodynamic, PIC and Atomic codes.

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**K1.00036 This work was performed under the auspices of the U.S. Department of Energy under contracts, DE-FG02-05ER46268**
K1.00036 The generation of warm dense matter according to numerical modeling of thick wire heating. 

1. VOLODYMYR MAKHIN, MILENA ANGELOVA, THOMAS AWE, BRUNO BAUER, IRVIN LINDEMUTH, IOANA PARASCHIV, RICHARD SIEMON, University of Nevada, Reno — Rad-MHD modeling with HDR given insight into a UNR experiment where 900-kA with a 70-ns rise time is driven through a 1-mm-diameter aluminum rod. The skin depth is smaller than the rod radius, so the aluminum is compressed by the pinch effect. However, experimentally the surface of the rod expands radially, even while the current is increasing. Expansion is expected and observed in thin wires, where magnetic forces are small compared with the pressure generated by Ohmic heating, but expansion is somewhat surprising in thick-wire experiments because magnetic forces are strong enough to retain the solid density. Simulations show expansion in these experiments results when the resistivity allows a small imbalance between magnetic forces and the pressure gradient, which allows material to slip through the magnetic field. Predicting the expansion is a challenge, because the expanding aluminum is primarily in the regime of warm dense matter, in which the ion-ion coupling parameter is larger than unity, and electrical resistivity estimates are difficult. In these simulations SESAME tables are used that include resistivity estimates from recent experiments and quantum-molecular-dynamic computations.

1Work supported by DOE grants DE-FG02-04ER45472 and DE-FG02-06ER45892.

K1.00037 Laboratory Experiments to Study Plasma Jet and Shock Using High-Power Lasers

YOUCIIH SAKAYA, S. DONO, T. KURAMITSI, T. KATO, T. KIMURA, K. MIYANISHI, T. ENDO, N. OZAKI, H. NACATOMO, K. SHIGEMORI, R. KODAMA, T. NARIMATSU, H. TAKABE, Osaka Univ., Japan, J. WAUGH, N. WOOLSEY, York Univ., UK, B. LOUPIAS, M. KOENIG, LULI, France — We describe laboratory laser-plasma experiments to form plasma jets and study jet driven shocks. Particular questions that are of interest are the formation and collimation of these jets, the relevance of experiment to astrophysical jets, and the formation of collisionless shock waves. The experiments were performed with Gekko XII HIPER laser system (3w, 500 ps, \( \sim 10^{15} \) W/cm²) at the Institute of Laser Engineering, Osaka Univ. Several types of targets were explored. The plasma jet and shock were measured with a side-on Mach-Zender interferometric diagnostic, and rear-surface self-emission diagnostics. These diagnostics enable the jet shape, electron density and temperature to be inferred.

K1.00038 Shaped mass limited target acceleration by ultra high intensity laser pulses. ALEXANDRE ANDREEV, KONSTANTIN PLATONOV, Vavilov State Optical Institute. VAVILOV STATE OPTICAL INSTITUTE TEAM — Ultrahigh intensity (UHI) laser pulses may accelerate ions in thin targets to high energies and highly collimated beams may be formed. In order to avoid the slowly moved regions of a larger foil as charge separation effects it has been proposed to use a small target with radius about laser spot size, so named mass limited target (MLT). Ion acceleration in targets irradiated by short ultra-intense laser pulses has been studied with analytical model and 2D3V PIC simulations, which describe the complete process from the electron acceleration in the laser field to the ion bunch formation. Simulations were performed for sub \( \mu \)m-scale size plane targets (foils and foil sections) and curve foil sections. Energy spectra of fast ions, laser conversion efficiency to fast ions and the divergence of ion beams are compared for various types of targets. When MLT is irradiated by UHI laser pulse, the resulting pellet plasma is strongly accelerated forward. The kinetic energy of the ions in the bunch's densest region can exceed tens MeV at about solid density. The regime of a most effective acceleration is realized in the case when laser field is about electrostatic field of core of MLT. It is found that maximal ion energy can be significantly enhanced by choosing of MLT instead of foil of the same thickness.

K1.00039 Preheat measurement in the laser irradiated targets. KAZUTO OTANI, KEISUKE SHICEMORI, TATSUHIRO SAKAIYA, ATSUISHI SUNAHARA, YOICHI SAKAWA, MITSUO NAKAI, HIROYUKI SHIRAGA, HIROSHI AZECHI, KUNIOKI MIMA, Institute of Laser Engineering, Osaka-University — We measured the temperature at the rear surface of the planar target. The target preheating is the crucial problem for the experimental research with the high power laser irradiation. Especially, the fuel preheat can decrease the compression performance of the inertial confinement fusion targets. We applied two types of targets, one is simple foil of polyimide, and another is cryogenic liquid deuterium (LD) target. They are corresponding to the ablator and the fusion fuel in ICF target. The cryogenic LD target was sandwiched by thin polyimide foils in both sides of laser irradiation. We observed the self emitting light from the rear surface of the target. When the target is assumed blackbody, the spectrum of emission shapes Planck distribution and tells its temperature. The laser irradiated in the wavelength of 2 or 3 \( \mu \) to observe the difference of the effect of preheat by changing the laser wavelength. The preheat wavelength was observed by optical pyrometer and VISAR. We will show the experimental results in the presentation.

K1.00040 Plasma-hydro coupling in cassio, an Inertial Confinement Fusion Code from the Crestone Project. THOMAS MASSEER, JOHN WOHLBIE, CCS-2, Los Alamos National Laboratory — The Crestone Project at Los Alamos National Laboratory produces cassio, an ICF code. Currently cassio implements radiation hydrodynamics on an Eulerian AMR mesh along with a three temperature (3T) plasma physics model. A 3T model treats plasma as a single species fluid with separate electron and ion temperatures, and uses a radiation diffusion model, where a radiation temperature characterizes the radiation energy density. The evolution equations for the electron and ion specific internal energies contain nonconservative products (\( p\gamma p\gamma u \)), which requires an assumption about shock jump conditions. Assuming an isentropic discontinuity in electron quantities at the shock permits semi-analytical solutions for simple fully ionized flows; these flows exhibit differential shock heating of the electrons and ions with relaxation to a common temperature. We have developed an Eulerian Godunov-based scheme for computing such shocks. We provide details for the model, method, and semi-analytic solutions, and compare results of the method to the semi-analytic solutions.

K1.00041 Superintense ion beam with high energy density. VADIM DUDNIKOV, USPTO, GALINA DUDNIKOVA, UMD CP — The energy of ion beam accumulated in a storage ring can be increased dramatically with using of space charge compensation as was demonstrated in experiments [1]. The intensity of said superintense beam can be far greater than a space charge limit without space charge compensation. The model of secondary electron avalanche build up with secondary ion-electron emission as a source of delayed electrons has been presented and discussed. This model can be used for explanation of bunched beam instability with electron surviving after gap, for prediction of e-cloud generation in coasting and long bunches beam, and can be important for pressure rise in warm and cold sections of storage rings. A fast desorption by ion of physically adsorbed molecules can explain a “first pulse instability”. Application of this model for e-p instability self-stabilization and superintense circulating beam accumulation is considered. Importance of secondary plasma for high performance ion beam stabilization in ion implantation will be considered. Preliminary results of simulation of electron and ion accumulation will be presented [1]. Belchenko et al., Xth International Particle Accelerator Conference, Protvino, 1977, Vol. 2, p. 287.

K1.00042 Multiview core imaging of OMEGA direct-drive implosions. T. NAGAYAMA, R. MANCINI, University of Nevada, Reno, R. TOMMASINI, J. KOCH, Lawrence Livermore National Laboratory, J. DELETTREZ, S. REGAN, V. MALYUK, Laboratory for Laser Energetics — We discuss the observation and data analysis of OMEGA direct-drive implosion cores based on data recorded with three identical multi-monochromatic x-ray imagers. These instruments observed the implosion core along three quasi-orthogonal lines-of-sight, and recorded gated images of the core. The targets were plastic shells filled with deuterium gas and a tracer amount of argon for diagnostic purposes. Core imaging was based on argues Lya, HeII and LyLi line emission. The data analysis rely on detailed spectral models that take into account non-equilibrium atomic kinetics, Stark broadened line shapes, and radiation transport calculations and a search and reconstruction technique based on a novel application of Pareto genetic algorithms to plasma spectroscopy. The spectroscopic analysis yields the spatial profiles of temperature and density in the core at the collapse of the implosion.

1This work is supported by DOE/NLUF Grant DE-FG52-07NA28062, LLNL.
K1.00043 EUV emission of warm dense plasma on an aluminum surface driven by a pulsed MG field. STEPHAN FUELLING, BRUNO S. BAUER, RICHARD E. SIEMON, THOMAS J. AWE, VOLODYMYR MAKHIN, TASHA GOODRICH, ANDREW OXNER, RADU PRESURA, University of Nevada, Reno — Plasma formation on an aluminum surface in the vicinity of high pulsed magnetic fields is studied using the UNR 1 MA Zebra generator. This physics is important in a number of applications including magneto-inertial fusion. A variety of 1-mm diameter loads with different contact configurations were tested to minimize or inhibit plasma initiation due to contact arcing. The rod diameter was larger than the skin depth for the 70-nsec current rise. The rods were monitored by an array of AXUV photodiodes with directly deposited filters to record plasma emissions in the extreme ultraviolet (EUV). Other diagnostics included optical imaging to a time-gated intensified CCD camera and a streak camera, magnetic field probes, photodiodes, photomultipliers, and laser schlieren and shadowgraphy. These yielded information on the threshold for plasma formation, the expansion of the aluminum, the temperature at the surface, and the growth of the unstable \( m=0 \) mode. The relatively simple experimental setup was chosen to allow comparison with 1-D and 2-D rad-MHD modeling.

K1.00044 Simple Map in Action-Angle Coordinates. OLIVIA KERWIN, ALKESH PUNJABI, HALIMA ALI, Hampton University — The simple map is the simplest map that has the topology of a divertor tokamak. The simple map has three canonical representations: (i) the natural coordinates - toroidal magnetic flux and poloidal \( \theta \) angle, (ii) the physical coordinates - the physical variables \( X,Y \) or \( \{r,z\} \), and (iii) the action-angle coordinates - \( A(\Theta) \) or magnetic coordinates \( (\mathbf{v}, \Theta) \). All three are canonical coordinates for field lines. The simple map in the \( \{X,Y\} \) representation has been studied extensively.\(^1\)\(^2\) Here we analytically calculate the action-angle coordinates and safety factor \( q \) for the simple map. We construct the equilibrium generating function for the simple map in action-angle coordinates. We derive the simple map in action-angle representation, and calculate the stochastic broadening of the ideal separatrix due to topological noise in action-angle representation. We also show how the geometric effects such as elongation, the height, and width of the ideal separatrix surface can be investigated using a slight modification of the simple map in action-angle representation. This work is supported by the following grants US Department of Energy - OFES DE-FG02-01ER54624 and DE-FG02-01ER54624 and DE-FG02-04ER54793 and National Science Foundation - HDR-0650372 and 0411394. \(^1\)A. Punjabi, H. Ali, T. Evans, and A. Boozer, Phys Lett A, 364 140-145 (2007). \(^2\)A. Punjabi, A. Verma, and A. Boozer, Phys.Rev. Lett. 69, 3322 (1992).

K1.00045 Effect of elongation in divertor tokamaks. MORGIN JONES, HALIMA ALI, ALKESH PUNJABI, Hampton University — Method of maps developed by Punjabi and Boozer [A. Punjabi, A. Verma, and A. Boozer, Phys.Rev. Lett. 69, 3322 (1992)] is used to calculate the effects of elongation on stochastic layer and magnetic footprint in divertor tokamaks. The parameters in the map are chosen such that the poloidal magnetic flux \( \chi_{SEP} \) inside the ideal separatrix, the amplitude \( \delta \) of magnetic perturbation, and the height \( H \) of the ideal separatrix surface are held fixed. The safety factor \( q \) for the flux surfaces that are nonchaotic as a function of normalized distance \( d \) from the O-point to the X-point is also held approximately constant. Under these conditions, the width \( W \) of the ideal separatrix surface in the midplane through the O-point is varied. The relative width \( w \) of stochastic layer near the X-point and the area \( A \) of magnetic footprint are then calculated. We find that the normalized width \( w \) of stochastic layer scales as \( W^{-7} \), and the area \( A \) of magnetic footprint on collector plate scales as \( W^{-10} \).

K1.00046 Spectroscopy of Highly Charged Ions at the NIST Electron Beam Ion Trap Facility. JOHN GILLASPY, ILIJA DRAGANIC, JOSHUA POMEROY, YURI RALCHENKO, JOSEPH READER, NIST, Atomic Physics Division, Gaithersburg, MD 20899-8422, ERIC SILVER, Harvard-Smithsonian Center for Astrophysics, 60 Garden St., Cambridge, MA 02138 — We will report on progress in the spectroscopy of highly charged ions which has recently taken place at the NIST Electron Beam Ion Trap Facility. This work is focused on the areas of laboratory astrophysics and fusion energy plasma diagnostics.

K1.00047 Constructions of non-equilibrium plasma model and applications to LHD/Solar plasmas. NORMASAMA YAMAMOTO, Osaka University, TAKAKO KATO, KUNINORI SATO, HISAMICHI FUNABA, CHIHIRO SUZUKI, NAOKI TAMURA, DAIJI KATO, HIROYUKI SAKAUE, National Institute for Fusion Science, NOBUYUKI NAKAMURA, University of Electro-Communications, PETER BEIERS-DORFER, Lawrence Livermore National Laboratory, Livermore, JAAN LEPSO, University of California, HIROAKI NISHIMURA, Osaka University, TETSUYA WATANABE, National Astronomical Observatory of Japan — HINODE satellite has high precise and high resolution EUV spectrometer, which is called EIS. Two bands of 170-210A and 250-290A are measured by EIS and measurements of many iron lines from Fe VIII to Fe XXIV are expected. In order to analysis of spectral lines from solar plasmas, which is non-equilibrium plasma, the development of non-equilibrium plasma model is necessary. In this paper, our constructed collisional-radiative model to assume quasi-steady states is applied to laboratory plasmas of LHD (Large Helical Device) and EBIT (Electron Beam Ion Trap). Then it’s applied to solar plasma by EIS/HINODE. Particularly, line intensities of Fe XIII (196-210A), which have strong density dependence, are studied about temperature/density dependence and atomic data sets dependence.

K1.00048 Plasma Formation on the Surface of nm-Diameter Aluminum Rods by Pulsed Megagauss Magnetic Field. THOMAS AWE, RICHARD SIEMON, BRUNO BAUER, STEPHAN FUELLING, VLAD MAKHIN, IRV LINDEMUTH, University of Nevada, Reno — Megagauss magnetic field is pulsed on millimeter-diameter aluminum rods resulting in heating inside the skin depth, and plasma formation in a thinner layer at the surface. Driven by the University of Nevada, Reno-Nevada Terawatt Facility’s (UNR-NTF) 2TW Zebra Z-pinch, 1.0 MA is delivered to the load, rising to current maximum in ~100ns. The load radius is chosen to be larger than the skin depth, placing the experiment in the ‘thick wire’ regime. In contrast to a thin uniform-current- density exploding wire, a thick wire exhibits plasma and magnetic pressure balance during current rise. Free expansion is limited, resulting in high energy density and temperature. The experiment is designed to limit large scale instability growth until after peak field. During current rise, dynamic equilibrium is achieved for some 10’s of nanoseconds and quasi-stable aluminum plasma heated to over 10 eV is held between a 3-5 megagauss magnetic field and a cool, dense, liquid aluminum wall. Preliminary understanding of the evolution of the rod interior and surface plasma is detailed with both experimental and computational results. Plans for future experiments, including new load designs and diagnostics under development, are given.
K1.00049 Yukawa Monte Carlo (YMC) and Orbital Free Molecular Dynamics (OFMD) approaches for the eos of warm dense iron plasma, DOMINIQUE GILLES, CEA/DSM/IRFU/SAP, FLAVIEN LAMBERT, JEAN CLEROUIN, CEA/DAM/DIF — Yukawa Monte Carlo and Molecular Dynamics simulations are powerful techniques extensively used to compute plasma properties such as EOS or transport coefficients, but are limited to applications where the linear electronic screening assumption is valid (1). Recently we have shown that a modified scheme using density functional theory with a Thomas-Fermi kinetic energy functional for the electrons (OFMD) may be well suited to perform MD simulations at high densities and temperature, without any assumption on the electronic screening (2). For selected iron plasma conditions representative of warm and dense matter, we shall compare pressure results calculated using YMC and OFMD codes and QEOS (3) and Sesame EOS models (4) and discuss the influence of keys parameters, like ionization in Yukawa theory.


K1.00050 FEW BODY SYSTEMS POSTERS —

K1.00051 Manifestly covariant three-body bound state calculations, PIETER MARIS, Department of Physics and Astronomy, Iowa State University, Ames, IA 50011 — Two-body bound states can be described by the homogeneous Bethe-Salpeter equation. Analogously, three-body bound states can be described by a homogeneous integral equation for the bound state amplitudes. In ladder truncation, one can solve these body bound state equations numerically, without any further approximations. I show result for explicitly covariant calculations of bound states of three scalar particles and of bound states of two scalars and one fermion. I compare my results to a commonly used approximation to the Faddeev equation: namely a reduction to a bound state of a single particle and a (bound) two-particle state.

K1.00052 Relativistic Dynamics of Quasistable States: The Bakamjian-Thomas Construction, SUJEEV VICKRAMASEKARA, Grinnell College — We study a synthesis of the S-matrix description of resonances with the Bakamjian-Thomas (BT) construction of incorporating interactions into a system of relativistic quantum particles. The BT-construction does not assume the existence of local fields mediating interactions. Therefore, it constitutes a theoretical framework more general than that of quantum field theories and is also devoid of many of the mathematical and conceptual difficulties of the latter. Characterization of resonances by the poles of the S-matrix has many advantages, foremost among which is perhaps the gauge invariance of the definitions of mass and width, a problem with which the field theoretical definitions suffer. Our construction shows that there exists irreducible representations of the semigroup of fundamental causal transformations of the relativistic spacetime that provide a description of relativistic resonances. These representations are generated by the interaction-incorporating Poincaré Lie algebra obtained from a suitable BT-construction and are characterized by the S-matrix complex pole position and spin of the resonance.

K1.00053 Three body covariant, nonperturbative, relativistic scattering calculations using LMNP1, MARCUS ALFRED, Department of Physics and Astronomy, Howard University — Using a formalism developed by Lindesay, Markevich, Pastrana, and Noyes, scattering cross sections and amplitudes are calculated. Comparisons are made with experiments and other studies.

1Partial support provided by the National Science Foundation

K1.00054 Is There A Mechanics of Mind? , ROBERT JONES, Emporia State University — In his book “Extending Mechanics to Minds” (Cambridge U. Press, 2006) Jon Doyle suggests that the human mind operates according to mechanical principles. Now in contemporary cognitive science operations in the cognitive or “knowledge level” are performed by lower level components of the program level. This decomposition continues from the program level down through the logic level, circuit level, and device level. Each level has its own components and each is described by its own laws of operation (Unified Theories of Cognition, Allen Newell, Harvard U. Press, 1990). The circuit and device levels could just as easily be fabricated out of mechanical elements such as linkage differentials and racks and pinions (Mechanisms and Dynamics of Machinery, Mabie and Ocvirk, John Wiley and Sons, 1975, ch. 8). These mechanisms would then be exactly those governed by the mechanical principles that Doyle focuses on. But Doyle’s mistake is to apply the same laws to the cognitive level. Rather, I believe the cognitive level is best described by operations like knowledge base search, analogy, classification, compression, etc. (R. Jones, Trans. of the Kansas Acad. of Sci., vol. 109, no. 3/4, pg 159, 2006).

K1.00055 BEAM PHYSICS POSTERS —

K1.00056 G4Beamline Particle Tracking for Muon Beam Lines1, KEVIN BEARD, ROLLAND JOHNSON, THOMAS ROBERTS, Muons, Inc. — The development of bright muon beams, which are needed for muon colliders and neutrino factories and are usually required to pass through matter, is limited by the lack of user-friendly numerical simulation codes that accurately calculate scattering and energy loss in matter. Geant4 is an internationally supported tracking toolkit that was developed to simulate particle interactions in large detectors for high energy physics experiments, and includes most of what is known about the interactions of particles and matter. Geant4 has been partially adapted in a program called G4Beamline (G4BL) to develop muon beam line designs. We are continuing the development of G4BL to enhance its graphical user-interface and add other features to the program to facilitate its use by a larger set of beam line and accelerator developers. We describe the set of around thirty users currently using the program.

1Supported in part by DOE STTR grant DE-FG02-06ER86281

K1.00057 Propagation of electron and positron beams in long, dense plasmas1, PATRIC MUGGLI, USC, BRENT BLUE, CHRIS CLAYTON, UCLA, FRANZ-JOSEPH DECKER, MARK HOGAN, SLAC, CHENGKUN HUNAG, CHAN JOSHI, UCLA, TOM KATSOULEAS, USC, WEI LU, WARREN MORI, UCLA, CAOLLIONN O’CONNELL, ROBERT SIEMANN, DIETER WALZ, SLAC, MIAOMIAO ZHOU, UCLA — Electron beams with density larger than the plasma density can propagate through plasmas without significant emittance growth. The electron beam expels plasma electrons from the bunch volume and propagate in a pure, uniform ion column. In contrast, positron beams attract plasma electrons that flow through the positron bunch. As a result the plasma focusing force is nonlinear, a charge halo forms around the bunch, and the bunch emittance grows. After some distance into the plasma, the bunch emittance reaches an approximately constant value, and the beam and the plasma focusing force reach a steady state. Experimental results obtained with electron and positron bunches, as well as numerical simulation results will be presented.

1This work is supported by the US Department of Energy
K1.00058 Characteristic Behavior and Scaling Studies of Self Organized InP Nano-dots formed via keV and MeV irradiations. Dipak Paramani, Institute of Physics, India, Shikha Varma, Institute of Physics, India, Subrata Majumdar Collaboration, Smruti R. Sahoo Collaboration — The controlled formation of nano-dots, using ion beams as tool, has become important as it offers a unique method to generate non-equilibrium phases with novel physical properties and structures with nano-dimensions. We have investigated the formation of self-assembled nano-dots on InP(111) surfaces after 3 keV as well as 1.5 MeV ion beams at a large range of fluences. We have studied the scaling exponents of the evolved surfaces by utilizing the technique of Scanning Probe Microscopy (SPM). At keV energies ripening of the nano-dots is seen below a critical time whereas an inverse ripening is observed for longer durations. At the critical time square shaped array of nano-dots are observed. The dots are characterized by narrow height and size distributions. Nano-dots have also been observed at MeV ion irradations. Their size distribution though broad at lowest fluence decreases for larger fluences.

K1.00059 Generation of Electron Microbunches Trains with Adjustable Sub-picosecond Spacing,¹, Patric Muggli, USC, Vitaly Yakimenko, BNL, Themios Kallos, USC, Marcus Babziak, Karl Kusche, BNL — We demonstrate that trains of subpicosecond electron microbunches, with subpicosecond spacing, can be produced by placing a mask in a region of the beam line where the beam transverse size is dominated by the correlated energy spread. The particles are selected based on the scattering of their emittance at the mask. The experiment was performed with the Brookhaven National Laboratory Accelerator Test Facility 60 MeV beam. We show that the number, length, and spacing of the microbunches can be controlled through the parameters of the beam and the mask. Trains with one to eight equidistant microbunches have been produced. The microbunches spacing was adjusted in the 100 to 300 µm or 300 fs to 1 ps range. The train structure is measured using CTR interferometry. Such microbunch trains can be further compressed and accelerated, and have applications to free electron lasers (FELs) and plasma wakefield accelerators (PWFA).

¹This work is supported by the US Department of Energy

K1.00060 NUCLEAR PHYSICS POSTERS —

K1.00061 Investigations toward the possible use of energy from isomeric nuclei, Marc Litz, George Merkel, Army Research Laboratory, Nino Pereira, Ecopulse Inc, James Carroll, Youngstown State University — The high energy density of some isomeric nuclei would be very attractive in energy storage applications if it could be extracted and converted to electricity conveniently and efficiently. These concepts were critically discussed in our presentation last year, but at that time no experimental results were available. This paper presents the results obtained in connection with irradiating two isotopes, 177Lu and 166Ho, with nominally 2 MV bremsstrahlung from a linear accelerator. Results include verification of the end point energy and the associated dosimetry, and changes in the samples’ activities and their causes.

K1.00062 Status of the Charged Pion Production Cross Section Measurements at MIPP, Gural Aydin, The University of Iowa — The MIPP (Main Injector Particle Production) Experiment is a fixed target experiment at Fermilab to measure hadronic production for different targets and beam energies. Data were taken in 2005 on targets including aluminum, beryllium, bismuth, carbon, copper, and uranium, a cryogenic hydrogen target, and the NuMI target using six types of beam particles (pion, kaon, and proton of both charges) for the beam energies ranging from 5 GeV/c to 120 GeV/c. The MIPP experiment used Fermilab Main Injector protons as 120 GeV/c beam. We present the status of the charged pion production cross section measurements of 58 GeV/c and 120 GeV/c proton beam on a thin carbon target in terms of final state particle’s longitudinal and transverse momenta.

K1.00063 RADIATION SOURCES POSTERS —

K1.00064 A Solid Oxygen Ultra-Cold Neutron Source, Christopher Lavelle, Chen-Yu Liu¹, Yun Shin, Indiana University — Ultra-Cold Neutrons (UCN) are produced in super-thermal sources via a single inelastic down scattering event of a low energy neutron in a medium. Solid deuterium and liquid helium are the primary sources of UCN for fundamental physics research due to very low absorption cross-sections and good transparency to UCN. Solid Oxygen is an attractive alternative because it has a lower absorption cross-section and theoretically higher potential to down scatter cold neutrons to the UCN energy regime via magnon excitation. A solid oxygen source could then produce higher densities of UCN in a larger volume, enhancing the UCN flux available to experiments by as much as an order of magnitude. We present an apparatus for testing UCN production in a cold neutron beam such as at Los Alamos Neutron Scattering Center as well as a proposed UCN source based on solid oxygen for Indiana University.

¹Principal Investigator

Sunday, April 13, 2008 3:10PM - 4:25PM — Session 11HE HEDP HEDLA: Physics of Planetary Interiors Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade F

3:10PM 11HE.00001 Super Earths: The Structure of Massive Terrestrial Planets, Diana Valencia¹, Harvard University — Super-Earths are the newest class of extra-solar planets with a mass range between 1-10 M⊕. We investigate the composition and structure of these planets. With their larger masses, they experience very large internal pressures. We find that the central pressure scales proportionately with mass, reaching values that challenge the understanding of rock behavior under such extreme conditions. Pressure also constrains the power law relationship between mass and radius of solid planets. The value for the exponent is 0.262 for super-Earths and 0.3 for planets between 5-50% M⊕ reaching values that challenge the understanding of rock behavior under such extreme conditions. Despite uncertainties in the equation of state, composition and temperature structure, the mass-radius relationship is robust. Therefore, it is useful for inferring the expected signal in transit searches. In the next few years many super-Earths will be discovered and their masses and radius will be available. We find that there is a large degeneracy in composition that can fit an average density measurement.

¹In collaboration with: Richard O'Connell, Harvard University; and Dimitar Sasselov, Harvard-Smithsonian Center for Astrophysics.

3:35PM 11HE.00002 Reproducing planetary cores in the laboratory, Jon Eggert, LLNL — This abstract not available.
4:00PM 11HE.00003 First Principle Calculations of Hydrogen-Helium Mixtures and the Structure of Jupiter1, BURKHARD MILITZER, UC Berkeley — Most of the over two hundred recently discovered extrasolar planets are gas giants that are primarily composed of dense fluid hydrogen and helium at megabar pressures and temperature of thousands of degrees Kelvin. The characterization of hydrogen-helium mixtures at such extreme conditions has posed a challenge to experimental and theoretical methods. Great progress has been made with recent shock wave experiments and the megabar regime has been probed. However, the temperatures were much higher and the densities were significantly lower than those present in giant planets because planetary interiors are characterized by isentropes, which rise much slower in the P-T plane than shock Hugoniot curves. In this talk, results from an extensive set of density-functional molecular dynamics simulations will be presented [J. Vorberger et al., Phys. Rev. B 75 (2007) 024206] and an equation of state (EOS) of hydrogen-helium mixtures that spans for Jupiter’s interior is derived. Going beyond the commonly assumed linear mixing approximation, the interaction effects of dense hydrogen and helium are analyzed. It will be discussed how helium affects the molecular-to-metallic transition in hydrogen and why the presence of helium stabilizes the molecular phase. Based on this first-principles EOS, an updated model for the interior of Jupiter will be introduced. Our interior model updates the suite of models that were based on the widely used Saumon-Chabrier-Van Horn (SCVH) EOS. Deviations from SCVH are up to about 5 percent depending on the pressure, and thus affect interior models at the same level. Unlike SCVH, the computed DFT-EOS does not predict any first-order thermodynamic discontinuities associated with pressure-dissociation and metallization of hydrogen. Finally, the size of a rocky core in Jupiter and the heavy elements enrichment in its mantle will be estimated. It will be discussed whether the planet was form by core-accretion.

3:30PM M2.00002 Results and Prospects for Direct Dark Matter Detection via Cryogenic Techniques, JODI COOLEY, Stanford University — Overwhelming observational evidence indicates that most of the matter in the Universe consists of non-baryonic, particle dark matter. One compelling candidate for particle dark matter is the Weakly Interacting Massive Particle (WIMP). After reviewing some of the evidence for dark matter and the WIMP hypothesis, I will describe current cryogenic techniques used to search for dark matter. I will present recent results from the Cryogenic Dark Matter Search (CDMS) in the Soudan Mine, MN, review the results of several other cryogenic experiments, and give prospects for future cryogenic dark matter experiments.

4:06PM M2.00002 Axions and Their Possible Role as Dark Matter, LESLIE ROSENBERG, University of Washington — The axion is a hypothetical elementary particle whose existence would explain the baffling absence of CP violation in the strong interactions. Its properties in addition make it a good dark-matter candidate. Even though dark-matter axions would make up the overwhelming majority of mass in the universe, they are notoriously difficult to detect. Undaunted, groups around the world deploy exquisitely sensitive axion detectors. These instruments are elegant and beyond state-of-the-art in novel ways. I’ll review the role of axions as dark matter and the methods employed in searches.

4:42PM M2.00003 What can we learn from future dark energy probes?, ANDREAS ALBRECHT, UC Davis — I briefly review the fundamental physics motivations for the study of dark energy and then take up the problem of assessing of the impact of propose dark energy experiments. I consider in turn a variety of approaches, from forecasting the impact of data on abstract dark energy parameters to exploring its impact on specific scalar field models. The Dark Energy Task Force model data sets are used to provide common points of comparison. I show that a remarkably consistent picture emerges from these diverse methods.

3:30PM M3.00001 Review of results on polarized glue from fixed target DIS experiments, GERHARD K. MALLOT, CERN — The question of how the spin of the nucleon is made up from the spins and orbital angular momenta of its constituents is now in the front line since two decades. Due to the smallness of the contribution from the quark spins the focus is on the gluon polarization \( \Delta g / g \). Our present knowledge of this quantity as obtained from deep-inelastic lepton–nucleon scattering experiments is mainly based on the recent results from COMPASS at CERN and HERMES at DESY. The main tools to study \( \Delta g / g \) in DIS are scaling violations of the \( g_1 \) structure function and—in a more direct way—longitudinal double spin asymmetries in hadron production. For the latter the information on the gluon polarization enters the asymmetries via the photon–gluon fusion part of the cross-section. The relative contribution of this part must be determined using Monte Carlo simulations before the gluon polarisation can be determined. Results are shown from hadron pairs produced with \( Q^2 < 1 \text{ GeV}^2 \) and \( Q^2 > 1 \text{ GeV}^2 \) as well as from single hadrons. In the case of charged mesons basically only the photon–gluon fusion process contributes and thus the analysis is almost independent of MC simulations. Recent results from COMPASS obtained from \( D \) meson asymmetries are presented and an outlook is given. All data indicate that the gluon polarization is small compared to earlier expectations, but still can make a major contribution to the nucleon spin.

4:06PM M3.00002 Review of recent results from RHIC on the polarized gluon distribution, GERRY BUNCE, BNL and RIKEN BNL Research Center — RHIC provides a unique laboratory to study the spin structure of the proton, using strongly interacting probes. Through remarkable control of the proton acceleration process, RHIC has achieved collisions with 55 to 60% polarized proton beams, at root(s)=200 GeV, with high luminosity. Two experiments, PHENIX and STAR, feature measurements of inclusive production of jets, jet fragmentation products (with emphasis on \( p_T^2 \)), and direct photons, which probe the gluon polarization in the polarized protons. I will discuss how we connect the measurements to the underlying physics and the present (sensitive) and future constraints on the gluon spin contribution from RHIC.

Work supported by the U.S. DOE, U.S. NSF, RIKEN Laboratory, Japan, and a sponsored research grant from Renaissance Technologies Corporation.
4:42PM M4.00003 Beller Lectureship Talk: Theoretical status and advances in understanding the role of polarized gluons

1. DANIEL DE FLORIAN, Universidad de Buenos Aires — The contribution of quarks and gluons to the spin of the proton has been a puzzle since the first precise polarized measurements performed 20 years ago. In this talk, after summarizing the current knowledge on spin dependent parton distributions, I will present the results of a global QCD (NLO) analysis of all available polarized data. The inclusion of the recent proton-proton RHIC data, plus the DIS inclusive and semi-inclusive measurements allows attempting for a more precise determination of the gluon polarization. I will put special emphasis on the value obtained for the first moment of the gluonic distribution, the actual contribution of gluons to the spin of the nucleon.

1Supported by the APS with the Beller Lectureship.

Sunday, April 13, 2008 3:30PM - 5:18PM
Session M4 DCOMP: Computational Physics Education

3:18PM M4.00001 CiSE and Computational Physics: Undergraduate Physics Challenge

1. DENIS DONELLY, Siena College — The role of Computing in Science and Engineering (CiSE) in support of computational physics is discussed with emphasis on CiSE's computational physics challenge. Winners awards are $1500, $1000, and $500. Each winner also receives a copy of Mathematica plus modest travel support. The challenge was for undergraduates at any accredited educational institution. Applicants were to select a physically and computationally interesting problem of their own choosing. Awards are presented at this session. Student winners discuss their work in papers that follow. First prize winner is Yevgeny Binder, of Loyola University in Chicago - "PartonKit: A C Program for Fast Parton Evolution with the Rossi Method." Second prize winner is John Barrett, of the University of Massachusetts Amherst - "Analysis of Photon Transport in 3 Polarized Scintillating Target Prototypes." Third prize winner is Steven Anton, of the University of Delaware - "Electron Wave Packet Propagation in Graphene Nanoribbons."

1Thanks to Shodor Foundation, SC07, TeraGrid, SPS, and Siena College Physics

4:06PM M4.00003 CiSE Computational Physics Challenge Winner: Analysis of Photon Transport in Scintillating Target Prototypes

1. JOHN BARRETT, RORY MISKIMEN, University of Massachusetts Amherst — A proposed experiment to measure the spin polarizabilities of the proton through double polarized Compton scattering requires a polarized proton target. One possible option for the target material that would enable background rejection is the use of a polarized scintillator. However the optimal geometry of this scintillating target is difficult to determine. By developing a Monte Carlo simulation of light transport in several proposed geometries it is possible to characterize which is the most effective design to collect scintillation light. We present our computational algorithm and recommendations for the future scintillating target geometry.

1Advisor

4:18PM M4.00003 CiSE Computational Physics Challenge Winner: Fast parton evolution and the search for gluon asymmetry in the hadron with PartonKit

1. YEVGENY BINDER, Loyola University Chicago, GORDON RAMSEY, Loyola University Chicago / Argonne National Laboratory — In the search for well-defined structure in the hadron, deep inelastic scattering (DIS) provides experimental data for a portion of the $J_\perp = \frac{1}{2}$ sum rule. For all terms to be fully determined, it is necessary to derive the longitudinally polarized gluon distribution from unpolarized DIS experiments, as well as from theoretical modeling and parton evolution. We have created a new computer program to perform parton evolution using the method devised by G. Rossi, which provides fast, stable results while remaining in x-space. Using this program, we have found a preliminary range of viable gluon asymmetries, which generate polarized gluon distributions.

4:30PM M4.00004 CiSE Computational Physics Challenge Winner: Electron Wave Packet Propagation in Graphene Nanoribbons

1. STEVEN M. ANTON, University of California, Berkeley — While graphene has been studied by theoreticians for over half a century, the two dimensional crystal lattice has only recently been realized experimentally. As such, theoretical work in the properties of graphene has exploded. A variety of these properties, which are truly exceptional and unique, have engendered much research into carbon based electronics, of which graphene is generally the most fundamental unit. In this thesis, we seek to characterize basic electronic properties of graphene nanoribbons. We begin with a tight-binding model of graphene and an analysis of the electronic band structure of the infinite sheet and semi-infinite nanoribbons. Also employing the spectral method, we create, inject, and propagate various types of wave packets infinite wires. A key effect that is expected is the so called Zitterbewegung oscillation of the wave packet center. Results are compared to theoretical predictions based on analytical methods rather than numerical simulations.

4:42PM M4.00005 Computational Physics as a Path for Physics Education

1. RUBIN H. LANDAU, Computational Physics Program, Oregon State University — Evidence and arguments will be presented that modifications in the undergraduate physics curriculum are necessary to maintain the long-term relevance of physics. Suggested will a balance of analytic, experimental, computational, and communication skills, that in many cases will require an increased inclusion of computation and its associated skill set into the undergraduate physics curriculum. The general arguments will be followed by a detailed enumeration of suggested subjects and student learning outcomes, many of which have already been adopted or advocated by the computational science community, and which permit high performance computing and communication. Several alternative models for how these computational topics can be incorporated into the undergraduate curriculum will be discussed. This includes enhanced topics in the standard existing courses, as well as stand-alone courses. Applications and demonstrations will be presented throughout the talk, as well as prototype video-based materials and electronic books.

1Previous support from the NSF's CCLI and EPIC programs

Sunday, April 13, 2008 3:30PM - 5:18PM
Session M5 DAP: Recent Results in Gamma-Ray Astrophysics

3:42PM M5.00001 Recent Results in Gamma-Ray Astrophysics

1. D. BORWELL, California Institute of Technology — The recent detector developments in gamma-ray astronomy have made it possible to study the gamma-ray emission from a wide variety of astronomical objects. These developments include the NASA Fermi mission, which will detect photons above 100 MeV for the first time, as well as the future gamma-ray observatories, such as NASA's AGILE mission. Recent results from Fermi and AGILE include the discovery of new gamma-ray sources, such as blazars and gamma-ray bursts, and the study of the gamma-ray emission from known sources, such as AGNs and supernova remnants. These results are discussed in this talk.
3:30PM M5.00001 Gamma-ray Observations of Extragalactic Particle Accelerators, HENRIC KRAWCZYNSKI, Washington University in St. Louis — With the ground based VERITAS, MAGIC, MILAGRO, and HESS experiments and the upcoming space-borne GLAST observatory, we now have access to a powerful suite of telescopes to probe high-energy particle populations in a wide range of astrophysical systems. In this contribution, I discuss the science topics that can be addressed with observations of high-energy particles accelerated close to supermassive black holes, in normal and starburst galaxies, and by large scale structure formation shocks. Furthermore, I will highlight recent results obtained with ground based gamma-ray telescopes.

4:06PM M5.00002 The Gamma-ray Large Area Space Telescope (GLAST)¹, STEVEN RITZ, NASA GSFC and U. Maryland — The Gamma-ray Large Area Space Telescope, GLAST, is a mission to measure the cosmic gamma-ray flux in the energy range 20 MeV to >300 GeV, with supporting measurements for gamma-ray bursts from 8 keV to 30 MeV. The very large field of view will make it possible to observe 20% of the sky at any instant, and the entire sky on a timescale of a few hours. With its upcoming launch, GLAST will open a new and important window on a wide variety of phenomena, including black holes and active galactic nuclei; the optical-UV extragalactic background light, gamma-ray bursts; the origin of cosmic rays and supernova remnants; and searches for hypothetical new phenomena such as supersymmetric dark matter annihilations and Lorentz invariance violation. In addition to the science opportunities, this talk includes a description of the instruments, the opportunities for guest investigators, and the mission status.


4:06PM M5.00003 Very High Energy Gamma Ray Astronomy, JORDAN GOODMAN, University of Maryland — In the last decade the number of detected TeV gamma ray sources has gone up by more than an order of magnitude. This is due to the increased sensitivity of the current generation of telescopes. Imaging Atmospheric Cherenkov Telescopes such as HESS, MAGIC and VERITAS have exploited their high sensitivity and excellent angular resolution to discovered and map new classes of galactic gamma ray sources while continuing to discover and monitor extra-galactic AGN. In addition, Milagro, using water Cherenkov technology, has used its large field of view and continuous exposure to observe large scale diffuse emission from the Galactic plane and extended sources. In addition it has detected galactic sources with flat spectra extending beyond 100 TeV. The combination of these techniques are giving us a new view of the TeV sky and providing tantalizing evidence of the sources of Galactic cosmic rays. This talk will review recent results and discuss prospects for future detectors.

Sunday, April 13, 2008 3:30PM - 5:18PM – Session M6 FPS FGSA: Equipping Scientists to Run for Political Office Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade D


3:40PM M6.00002 I WISH It Was Rocket Science: Lessons Learned from School Board Service ¹, PHILIP W. HAMMER, The Franklin Institute — In this talk I will share my experience of election to the Haddon Heights, New Jersey Board of Education and my event-filled path to Board presidency. As a board member, I have worked with taxpayers, teachers, administrators, unions, fellow board members, students, and parents with the goal of improving public education in this small suburban district. In a state where every year the electorate simultaneously votes on their town’s school budget, whether to increase their property taxes, and elect a new Board of Education, school board service presents a fascinating set of challenges and opportunities. I hope to convince other physicists that serving on their local school board is a great and personally rewarding way to have direct positive impact on local public education. I will also convey some important lessons learned about politics, education policy, and leadership.

3:50PM M6.00003 State School Boards: Winning the Election and Achieving Your Goals, MARSHALL BERMAN, NM State Board of Education — For political novices, planning an election campaign can be a difficult but potentially very rewarding activity. It is essential that you pick a qualified treasurer and a team dedicated to your goals and your election. Fund raising is usually minimal for this office. If you succeed in getting elected, you will face many challenges rarely connected to your scientific research, but often connected to the scientific method. You will again become a freshman. It is now essential that you gain the trust and confidence of your fellow Board members, and begin to move into committees, chairmanships, and possibly higher offices. You must learn to understand and work with other Board members. I will discuss my election campaign, and my subsequent four years on the New Mexico State Board of Education, including successes and areas of improvement.

4:00PM M6.00004 TBA, LESLEY STONE, Scientists and Engineers for America — This abstract not available.

4:10PM M6.00005 Scientists Serving in Public Office, MICHAEL FORTNER, State Representative for the 95th District of Illinois and Northern Illinois University — This abstract is not available.

4:20PM M6.00006 Panel Discussion —

Sunday, April 13, 2008 3:30PM - 5:18PM – Session M7 GGR COM: The Broad Spectrum of Gravitation Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Rose Garden

4:20PM M6.00005 Scientists Serving in Public Office, MICHAEL FORTNER, State Representative for the 95th District of Illinois and Northern Illinois University — This abstract is not available.

4:30PM M7.00001 Binary black hole simulations, MANUEL TIGLIO, University of Maryland — I will describe recent progress on binary black hole simulations using a combination of already established techniques and new ones. Among the latter, a “turducken” approach and a high order finite-difference multipatch one.

4:42PM M5.00002 The Gamma-ray Large Area Space Telescope (GLAST), JORDAN GOODMAN, University of Maryland — The Gamma-ray Large Area Space Telescope, GLAST, is a mission to measure the cosmic gamma-ray flux in the energy range 20 MeV to >300 GeV, with supporting measurements for gamma-ray bursts from 8 keV to 30 MeV. The very large field of view will make it possible to observe 20% of the sky at any instant, and the entire sky on a timescale of a few hours. With its upcoming launch, GLAST will open a new and important window on a wide variety of phenomena, including black holes and active galactic nuclei; the optical-UV extragalactic background light, gamma-ray bursts; the origin of cosmic rays and supernova remnants; and searches for hypothetical new phenomena such as supersymmetric dark matter annihilations and Lorentz invariance violation. In addition to the science opportunities, this talk includes a description of the instruments, the opportunities for guest investigators, and the mission status.

1 on behalf of the GLAST Mission Team

3:50PM M6.00003 State School Boards: Winning the Election and Achieving Your Goals, MARSHALL BERMAN, NM State Board of Education — For political novices, planning an election campaign can be a difficult but potentially very rewarding activity. It is essential that you pick a qualified treasurer and a team dedicated to your goals and your election. Fund raising is usually minimal for this office. If you succeed in getting elected, you will face many challenges rarely connected to your scientific research, but often connected to the scientific method. You will again become a freshman. It is now essential that you gain the trust and confidence of your fellow Board members, and begin to move into committees, chairmanships, and possibly higher offices. You must learn to understand and work with other Board members. I will discuss my election campaign, and my subsequent four years on the New Mexico State Board of Education, including successes and areas of improvement.

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4:06PM M7.00002 Recent developments in loop quantum gravity, JORGE PULLIN, Louisiana State University — We review recent developments in loop quantum gravity emphasizing its applications in mini and mid-superspace situations.
3:30PM M8.00001 White Paper on the Status and Future of Ground-based Gamma-ray Astronomy - Overview, V. VASSILIEV, ON BEHALF OF WP TEAM — In recent years, very high-energy (VHE) gamma-ray astronomy has attracted the attention of the wider scientific community due to a number of important astrophysical discoveries made by the newly constructed ground-based gamma-ray observatories H.E.S.S, VERITAS, MAGIC, and Milagro. Among the most important findings is the discovery of a new, enigmatic population of VHE gamma-ray sources in the Milky Way. To date, some 70 TeV sources have been detected and the high discovery rate is expected to be maintained in the forthcoming years, due to the ongoing operation and upgrades of ground-based gamma-ray observatories and the long anticipated launch of the space-based gamma-ray telescope, GLAST. The continuation of these achievements into the next decade will require a new generation of observatories. In view of the long lead time for developing and installing new instruments, the Division of Astrophysics of the American Physical Society has requested the preparation of a White Paper on the status and future of ground-based gamma-ray astronomy to define the science goals of a future observatory operating at energies above 10 GeV, to determine the performance specifications, and to identify the areas requiring technology development. We outline the history and the purposes of the White Paper and report on its findings, which are based on the numerous contributions from US and international scientists.

3:42PM M8.00002 The Advanced Gamma-ray Imaging System (AGIS), JAMES BUCKLEY, Washington University, AGIS COLLABORATION — We describe a concept for a ~1 km² ground-based gamma-ray experiment (AGIS) comprised of an array of ~100 imaging atmospheric Cherenkov telescopes achieving a sensitivity an order of magnitude better than the current generation of space or ground-based instruments in the energy range of 40 GeV to ~100 TeV. We present the scientific drivers for AGIS including the prospects for contributions to understanding extragalactic sources such as nearby galaxies, active galaxies, galaxy clusters and GRBs; galactic sources such as X-ray binaries, supernova remnants, and pulsar wind nebulae; as well as probes of fundamental physics including indirectly detecting dark matter and probing TeV-scale physics. With the current generation of atmospheric Cherenkov telescope arrays, TeV astronomy has become well established, with the number TeV gamma-ray sources now nearing 100, including many unidentified and serendipitous sources. Improvements in the instantaneous field of view, angular resolution, effective area and energy resolution of AGIS are certain to provide great scientific returns in high energy astrophysics as well as opening up new discovery space. Here we present an overview of the ongoing design studies for AGIS including the optimization of array parameters as well as an overview of the technical drivers for the observatory.

3:54PM M8.00003 Technology Development for AGIS (Advanced Gamma-ray Imaging System), FRANK KRENNRICH¹, Iowa State University — Next-generation arrays of atmospheric Cherenkov telescopes are at the conceptual planning stage and each could consist of on the order of 100 telescopes. The two currently-discussed projects AGIS in the US and CTA in Europe, have the potential to achieve an order of magnitude better sensitivity for Very High Energy (VHE) gamma-ray observations over state-to-the-art observatories. These projects require a substantial increase in scale from existing 4-telescope arrays such as VERITAS and HESS. The optimization of a large array requires exploring cost reduction and research and development for the individual elements while maximizing their performance as an array. In this context, the technology development program for AGIS will be discussed. This includes developing new optical designs, evaluating new types of photodetectors, developing fast trigger systems, integrating fast digitizers into highly-pixelated cameras, and reliability engineering of the individual components.

¹for the AGIS Collaboration
4:30PM M8.00006 A balloon-borne X-ray polarimeter for the study of bright astronomical sources, RAMANATH COWSIK, Washington University in St. Louis — Through astronomical X-ray polarimetry we can probe the extreme conditions of gravity near black holes, the intense magnetic fields near neutron stars and magnetars, the presence of very high energy particles in the shocks associated with supernova remnants, and a variety of exotic astrophysical processes such as Thomson scattering in the hot atmospheres above accretion disks and inverse Compton scattering of polarized synchrotron photons. In this paper we discuss an instrument suitable for balloon borne observations. This instrument consists of an azimuthally symmetric collimator with a trapezoidal response, which reduces the required pointing accuracy, and a position sensitive proportional counter which has external resistors distributed in series with the high voltage anode wire. This latter characteristic allows position of the scattered photon to be determined in angular steps through charge division and minimizes the on-board electronics and telemetry. A full analysis of the response of the instrument, including the competing effects of photoelectric absorption in the scattering target is presented. We show that the polarization of about a dozen astronomical x-ray sources may be probed effectively with this instrument during a long duration balloon flight from Antarctica.


5:06PM M8.00009 Recent Results from the Chandra Deep Field Surveys, WILLIAM BRANDT, Penn State Astronomy and Astrophysics, CHANDRA DEEP FIELDS TEAM — The deepest Chandra surveys continue to deliver fascinating results about active galactic nuclei (AGNs), starburst & normal galaxies, groups & clusters, and large-scale structures in the distant X-ray universe. I will review these surveys and describe some recent results from two of them, the Chandra Deep Field-North and Extended Chandra Deep Field-South. Specifically, I will describe (1) the X-ray-to-optical properties of AGNs probed over wide luminosity and redshift ranges, (2) the obscured AGN content of distant submillimeter galaxies, and (3) the X-ray evolution of non-active late-type and early-type galaxies over the last half of cosmic time. I will also discuss some key outstanding problems and prospects for short-term and long-term advances.

We gratefully acknowledge support from NASA.

Sunday, April 13, 2008 3:30PM - 5:06PM –
Session M10 GGR DAP: Gravitational Waves from Neutron Stars and Stochastic Backgrounds
Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis A

3:30PM M10.00001 Displacement Calibration Techniques for the LIGO Detectors, EVAN GOETZ, University of Michigan, LIGO SCIENTIFIC COLLABORATION — Calibration of the gravitational wave data channels of the Laser Interferometer Gravitational Wave Observatory (LIGO) is critical to determining the sensitivity of the detectors to spacetime perturbations produced by distant astronomical bodies. These detectors are designed to measure relative displacement fluctuations at the level of $10^{-19}$ m/$\sqrt{Hz}$ at 100 Hz. This calibration requires mirror displacement actuation that can be performed without disrupting the servo lock. For LIGO, the actuation for the length sensing and control servo uses voice-coils surrounding magnets glued to the suspended mirrors. This actuation has been calibrated using three techniques: simple Michelson, frequency modulation, and radiation pressure. These methods, which span a wide range of actuation strengths, will be described and compared.

3:42PM M10.00002 Beating the spin-down limit on gravitational wave emission from the Crab pulsar, MICHAEL LANDRY, LIGO Hanford Observatory, LIGO SCIENTIFIC COLLABORATION — Using nine months of data from the fifth science run of the LIGO Scientific Collaboration, we have determined new upper limits on the gravitational wave emission from the Crab pulsar. The result is a stronger constraint than that derived from arguments based on spin down and energy conservation, providing insight into the Crab energy budget. Limits from two searches are presented, one assuming the Crab pulsar emits gravitational radiation at twice the rotation frequency as determined by radio observations, while the other search relaxes this assumption and places an upper limit over a region in frequency and spin-down parameter space centered on twice the rotation frequency.

for the LIGO Scientific Collaboration.
3:54PM M10.00003 Results from the Einstein@Home search of the LIGO S4 data set. BRUCE ALLEN¹. Albert Einstein Institute, Hannover, Germany & U. Wisconsin – Milwaukee, LIGO SCIENTIFIC COLLABORATION — We present the results of an all-sky blind search for continuous gravitational waves generated by rapidly-spinning neutron stars. The search was carried out using 510 hours of data from LIGO’s fourth science run S4, using computer time donated by the general public. Since Einstein@Home was launched in 2005, more than 100,000 volunteers have contributed over 100 million CPU hours to the project.

1 for the LIGO Scientific Collaboration.

4:06PM M10.00004 Broadband Search for Continuous-Wave Gravitation Radiation with LIGO. VLADIMIR Dergachev, University of Michigan, LIGO SCIENTIFIC COLLABORATION — Isolated rotating neutron stars are expected to emit gravitational radiation of nearly constant frequency and amplitude. Searches for such radiation with the LIGO interferometers are underway, using data collected over the past several years. Because the gravitational wave signal amplitudes are thought to be extremely weak, long time integrations must be carried out to detect a signal. This is complicated by the motion of the Earth (daily rotation and orbital motion) which induces substantial modulations of detected frequency and amplitude that are highly dependent on source location. We present an algorithm called PowerFlux, used to account for these modulations, when summing power spectral density estimates incoherently over long time intervals. Current approaches to reconstruction of source parameters, coincidence analysis and outlier followup will also be discussed. We will show results from the application of the PowerFlux detection pipeline to a broadband search in the initial data of the S5 run.

4:18PM M10.00005 What can LIGO results say about mountains on pulsars? RICHARD O’SHAUGHNESSY. Penn State — Neutron stars containing quark matter might have ellipticities large enough to generate periodic gravitational waves detectable in LIGO’s recent data. Detection of a large ellipticity would indicate the presence of quark matter, but even upper limits can be interesting. A single upper limit does not constrain the composition of the star because any star may just happen to be very smooth, but a set of upper limits may constrain population statistics and deformation mechanisms. We consider two generic phenomenological models, a static power-law distribution of ellipticities and a dynamical scenario with generic mountain building and mountain shrinking processes. We describe how future LIGO observations, even if they are only upper limits, will constrain these models more than they are already constrained by pulsar spin-downs.

4:30PM M10.00006 R-modes in newborn neutron stars: nonlinear development. RUXANDRA BON-DARESCU, SAUL TEUKOLSKY, IRA WASSERMAN, Cornell University — Rotating neutron stars have modes that are driven unstable by the gravitational radiation, principally the “R-mode”, a L=m=2 Rossby wave. This instability is active when the gravitational driving dominates the internal fluid dissipation of the star. This enables the star to emit a significant fraction of its rotational energy and angular momentum as gravitational waves. It has been suggested that the R-mode instability could explain the relatively low spin frequencies observed in young pulsars. The frequency to which this instability can spin down the star depends on internal neutron star physics such as viscous dissipation, neutrino cooling and strength of magnetic fields. The nonlinear interactions between the R-mode and other near resonant modes in the star play a very important role in determining how this process works, and also illustrates how instabilities can saturate at low amplitudes. My talk will focus on discussing how nonlinear interactions affect the spin evolution of hot young neutron stars in the first few years after formation.

4:42PM M10.00007 Search for Stochastic Background of Gravitational Waves with LIGO. VUK MANDIC, University of Minnesota, LIGO SCIENTIFIC COLLABORATION — Laser Interferometer Gravitational-wave Observatory (LIGO) has built three multi-km interferometers, designed to detect gravitational waves. One of the possible sources targeted by LIGO is the stochastic background of gravitational waves, whose origin could be cosmological or astrophysical. LIGO has recently completed a year-long science run S5, with all three interferometers at their design sensitivities. We describe the most recent results of the search for the stochastic background of gravitational waves, based on the data from the S5 run.

4:54PM M10.00008 Stochastic Background of Gravitational Waves from Cosmological Sources. LARRY PRICE, XAVIER SIEMENS, University of Wisconsin-Milwaukee — Several mechanisms exist for generating a stochastic background of gravitational waves in the period following inflation. These mechanisms are generally “classical” in nature, with the gravitational waves being produced from inhomogeneities and not quantum fluctuations. The resulting stochastic background could be accessible to the next generation of gravitational wave detectors. In this talk we’ll discuss computational techniques and approximations for computing such a background. Specifically, we’ll focus on gravitational waves generated in a simple model of preheating.

Sunday, April 13, 2008 3:30PM - 5:18PM – Session M11 DPF: Higgs II
Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis B

3:30PM M11.00001 Search for charged Higgs in lepton+jets channel at CDF. GEUMBONG YU, University of Rochester, CDF COLLABORATION — We present a search for an anomalous boson in top decays using purely produced top events collected by CDF II detector at the Fermilab Tevatron. Our search focuses on a boson which decays into two jets, like hadronic W' decays in the lepton+jets tt decay processes. With well identified lepton and jets, reconstructed di-jet mass would represent higher mass than W' if there is another particle produced from top. We especially concern about charged Higgs(MSSM) in low tanb plane near 1 with mass between 90 GeV/c² and 150 GeV/c². Here we will present the sensitivity of finding such abnormal particle from top decays.

3:42PM M11.00002 Search for a Charged Higgs Boson with Decay to a Top Quark and a Bottom Quark at D0. CHRISTOPHER POTTER, McGill University, D0 COLLABORATION — The large mass of the top quark, close to the electroweak symmetry-breaking scale, makes it a good candidate for probing physics beyond the Standard Model. Single top quarks may be produced in the decay of a charged Higgs boson predicted by several extensions of the Standard Model. We present limits on the production cross section of such a particle using a 0.9 fb⁻¹ dataset.

3:54PM M11.00003 The ATLAS Charged Higgs Trigger Strategy and Discovery Potential. CHRIS POTTER, McGill University, ATLAS COLLABORATION — The charged Higgs boson is predicted in any extension of the Standard Model with two or more Higgs doublets. Since these models do not predict the mass of the charged Higgs boson, many scenarios are possible for its production, decay and discovery at the Large Hadron Collider. Trigger strategies for MSSM charged Higgs events with the ATLAS detector are discussed, as well as the discovery potential.
4:06PM M11.00004 Search for Neutral Supersymmetric Higgs Bosons in bbb(b) Final States

TIM SCANLON, Imperial College, London, D0 COLLABORATION — Many extensions of the Standard Model predict greatly enhanced production rates of neutral Higgs bosons in association with bottom quarks. This production manifests itself as an excess of events with 3 and 4 b-jets in the final states over the multijet background. We present results for a search for Higgs bosons in bh (→bb) and bb (→bb) channels using 2 fb$^{-1}$ of data collected by the D0 detector at the Tevatron.

4:18PM M11.00005 Search for Neutral Supersymmetric Higgs Bosons in di-tau Final States

WAN-CHING YANG, University of Manchester, UK, D0 COLLABORATION — In Supersymmetric models the Higgs boson production cross section can be significantly enhanced compared to the Standard Model. In such models, the Higgs boson has a significant branching ratio to tau leptons at all masses. We present a search for neutral Higgs boson production in the di-tau decay mode using data corresponding to 2 fb$^{-1}$ of integrated luminosity collected by the D0 experiment at the Tevatron collider.

4:30PM M11.00006 Search for Standard Model Higgs Particle in Two Photon Final State at LHC

JAEHOON YU, HYEONJIN KIM, University of Texas at Arlington, ATLAS COLLABORATION — The Higgs particle is a manifestation of the Higgs mechanism that gives masses to leptons and quarks and is the last missing piece in the Standard Model. The Higgs particle has been sought over the past three decades but has not been found. The precision measurements of masses of W vector bosons and the top quark have been providing valuable information in searching for the Higgs particle. The ATLAS experiment at the Large Hadron Collider facility is going to be turned on this year and will dramatically extend the kinematic range of the search for the Higgs particle. One of the cleanest channels for the search for the Standard Model Higgs is using its two photon or four electron final states. In preparation for the imminent turn on of the LHC and the experiment, we have been working on developing electron and photon identification algorithms using the covariant matrix technique. In this presentation, we present the results of the Higgs search strategy in its two photon final state using this technique at ATLAS experiment and its performance test using simulated data.

4:42PM M11.00007 ABSTRACT WITHDRAWN —

4:54PM M11.00008 Search for Higgs boson using a matrix-element technique at CDF

BARBARA ALVAREZ, JAVIER CUEVAS, Universidad de Cantabria, FLORENCIA CANELLI, Fermi National Accelerator Laboratory, BÉRND STELZER, University of California Los Angeles, ROCIO VILAR, Universidad de Cantabria, THE CDF COLLABORATION — We present a search for Higgs produced in association with a W boson using 2 fb$^{-1}$ of data accumulated with the CDF detector at the Fermilab Tevatron. Events used in this analysis are selected with one charged lepton, large missing transverse energy, and two or three jets, where at least one jet is identified as a b-quark jet using displaced secondary-vertex information from the silicon detector. Using a matrix-element analysis technique and a neural-network jet-flavor separator we improve separation of signal and background and greatly improve the sensitivity of our search.

5:06PM M11.00009 Search for Associated Production of W and Higgs Bosons in the All Hadronic Decay Mode

JUSTACE CLUTTER, University of Kansas, D0 COLLABORATION — We present a search for a low mass standard model Higgs Boson particle, produced via an associated W Boson, in the hadronic decay channel where the Higgs Boson particle decays into two b quarks and the W Boson decays into two light quarks. The dataset, collected at the D0 experiment at Fermilab, has a total integrated luminosity of 1 fb$^{-1}$. A basic set of cuts designed to prefer a Higgs Boson hadronic decay signature including but not limited to the total number of jets and the number of b quark jets in an event is applied to the data. The data is further enhanced for the Higgs Boson decay though the use of a decision tree trained on a combination of Monte Carlo signal simulations and an orthogonal data sample, designed to represent the dominant QCD background, based on the requirement for a single b quark jet in the event. Two dimensional fit to the invariant mass of the two b quark jets and the invariant mass of the remaining two light quark jets is explored as a technique to determine a limit on the production cross section of the standard model Higgs Boson.
4:06PM M12.00004 Top quark mass measurement in the lepton+jets and dilepton channels at CDF using a template method. HYUN SU LEE, University of Chicago, CDF COLLABORATION — We present a measurement of the top quark mass using the CDF detector at the Fermilab Tevatron in a 2 fb$^{-1}$ data sample observed in the lepton+jets and two leptons final states. In the lepton+jets channel, we determine the reconstructed top quark invariant mass in each event by minimizing a $\chi^2$ for the overconstrained kinematic system. At the same time, we measure the mass of the hadronically decaying $W$ boson in the same event sample, that provides an improvement in the determination of the jet energy scale. In the dilepton channel, the reconstruction of the top quark mass involves an under-constrained system due to two neutrinos in each event. We integrate undetermined kinematic variables and produce a probability distribution which gives the relative likelihood of different values of the top quark mass. We extract the top quark mass and the jet energy scale by comparing representative distributions constructed from simulated events to the data distribution. We simultaneously fit for the top quark mass and the jet energy scale using two observables in the lepton+jets and dilepton channels with a single likelihood.

4:18PM M12.00005 Measurement of the Top Quark Mass at D0 Using the Ideogram Method in the Lepton+Jets Channel. AMNON HAREL, University of Rochester, D0 COLLABORATION — We report on the measurement of the top quark mass based on a 1 fb$^{-1}$ sample of $t\bar{t}$ events in the lepton+jets final state. For each event, a probability based on the kinematic reconstruction of the event is calculated as a function of the top mass and the overall jet energy scale. The top mass and jet energy scale are extracted by maximizing a likelihood constructed as the product of the single event probabilities. The overall jet energy scale is constrained by the two jets from the hadronic $W$ boson decay.

4:30PM M12.00006 ABSTRACT WITHDRAWN —

4:42PM M12.00007 Measurement of the top production cross section rate from gluon-gluon fusion at CDF. JARED YAMAOKA, Rutgers University, CDF COLLABORATION — We present a measurement of the ratio of top-antitop production cross section via gluon-fusion to the total production cross section in proton-antiproton collisions with $\sqrt{s} = 1.96$ TeV at the Fermilab Tevatron. The data sample, recorded by CDF II, has an integrated luminosity of 955 pb$^{-1}$. Using an artificial neural network trained on the kinematics to discriminate the gluon-fusion events, we find the ratio of the gluon-fusion cross section to the total cross section to be $< 0.33$ at the 68% confidence level and $< 0.01$ at the 95% confidence level. Additionally, we combine this measurement with a complementary analysis using the charged particle multiplicity in top-antitop events and find the ratio to be 0.07$\pm$0.15-0.07.

5:06PM M12.00009 ABSTRACT WITHDRAWN —

Sunday, April 13, 2008 3:30PM - 5:18PM —
Session M13 DNP: Neutrinos I Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis F

3:30PM M13.00001 Solar neutrino flux results measured with the Neutral Current Detector array in the Sudbury Neutrino Observatory (SNO). KEITH RIELAGE, Los Alamos National Laboratory, SUDBURY NEUTRINO OBSERVATORY (SNO) COLLABORATION — In 2004, the Sudbury Neutrino Observatory (SNO) added an array of 3$^\text{He}$ proportional counters to the 1000 tonnes of heavy water. The Neutral Current Detector (NCD) array detects the neutrons liberated in the neutral current reaction of neutrinos on deuterium. The NCD measurement of the total flux of active solar neutrinos above 2.22 MeV is decoupled from the PMT-based measurements of the electron solar neutrino flux resulting in a smaller correlation between these fluxes in this phase than in the previous SNO results. The operation of the NCD array will be discussed. The solar neutrino flux results from this 385-live-day phase and the latest global combined fits for the solar neutrino mixing angle and mass difference will be discussed. This work was supported in part by the US Department of Energy Office of Science - Nuclear Physics.

3:42PM M13.00002 A Monte Carlo Simulation of the SNO Neutral Current Detector Array1, JOCELYN MONROE2, Massachusetts Institute of Technology. SNO COLLABORATION — The third phase of the Sudbury Neutrino Observatory is designed to make a systematically independent measurement of the total boron-8 solar neutrino flux, above the deuterium break-up threshold. A neutral current detector (NCD) array of 40 gas-filled proportional counters was deployed in the heavy water target. The dominant background to the neutrino capture signal is from alphons produced in the uranium and thorium decay chains inside NCD constituent materials. We have developed a full Monte Carlo of the signal and background production process, liquid scintillator quality control measures, and detector monitoring will be presented. The achieved background reduction after this first phase of purification and planned future work on KamLAND will be discussed.

3:54PM M13.00003 Low Background Phase of KamLAND. GREGORY KEEFER, The University of Alabama, KAMLAND COLLABORATION — The KamLAND collaboration operates a 1 kton liquid scintillation detector in the Kamioka mine in Japan. KamLAND’s main scientific results are the precision measurement of the solar $\Delta m^2$ utilizing reactor anti-neutrinos and first evidence for the observation of geologically produced anti-neutrinos. The KamLAND collaboration has been working toward upgrading the detector for a low background phase. During the spring of 2007, we performed the first phase of purification by circulating 1.3 ktons of KamLAND liquid scintillator through a newly developed distillation and purging system. The ultimate goal of purification is to allow for a direct measurement of the 862 keV, $^7$Be neutrinos originating from the Sun. A description of the purification process, liquid scintillator quality control measures, and detector monitoring will be presented. The achieved background reduction after this first phase of purification and planned future work on KamLAND will be discussed.
4:06PM M13.00004 Probing the Mystery of Neutrino Mass with CUORE, LARISSA EJIZAK, University of Wisconsin-Madison. CUORE COLLABORATION — Understanding the nature of neutrino masses will require physics beyond the long-standing Standard Model of particle physics. CUORE, the Cryogenic Underground Observatory for Rare Events, will be a next-generation experiment at Gran Sasso National Laboratory investigating neutrino masses through the mechanism of double beta decay. It will operate on the principle of bolometric calorimetry; the detector will consist of an array of 988 TeO$_2$ crystals with a total mass of 207 kg of $^{130}$Te, maintained at 10 mK. CUORE’s particular focus is the search for neutrinoless double beta decay, which, if observed, would indicate that neutrinos have Majorana masses — meaning that they are their own antiparticles, and in turn implying that lepton number, which so far has appeared to be a good symmetry of the Standard Model, is violated. CUORE will also be able to place improved limits on the absolute neutrino mass scale and possibly to determine the mass hierarchy of the three neutrino mass eigenstates. We will discuss the status of the CUORE project and present the latest results from CUORICINO, a prototype experiment currently running at Gran Sasso.

4:18PM M13.00005 Systematic Effects on Pulse Shape Analysis in HPGe Detectors for $0\nu\beta\beta$ Searches, VICTOR M. GEHMAN, Los Alamos National Laboratory, MAJORANA COLLABORATION — The MAJORANA Project will endeavor to provide direct limits on the effective Majorana mass of the electron neutrino through the measurement of neutralino double-beta decay in $^{76}$Ge. One of the techniques that the MAJORANA experiment will implement to separate single-site energy depositions (such as $0\nu\beta\beta$ or $2\nu\beta\beta$ events) from multi-site events (such as multiply scattering $\gamma$ rays) is pulse shape analysis. We present work performed at Los Alamos National Laboratory using a “CLOVER” detector (a close-packed array of four 800-g, two-fold segmented natural germanium detectors) to characterize systematic uncertainties in the survival probabilities of double-escape, Compton continuum and full-energy $\gamma$ ray events under two-moment parametric pulse shape cuts.

4:30PM M13.00006 P-type Modified Electrode Germanium Detector Impurity Profiles, JEREMY KEPHART, Pacific Northwest National Laboratory — Germanium detectors with unprecedented capabilities are needed for detecting ultra-rare events in future neutrinoless double-beta decay experiments, searches for dark matter, environmental monitoring programs, national security applications, and potentially neutrino astrophysics. An ideal detector would combine ultra-low background capabilities, minimal electronic instrumentation, extremely low energy threshold, and the ability to perform event reconstruction to determine the interaction type or the spatial distribution of ionization following an interaction. A germanium detector with a special, very low capacitance, contact geometry and presumably a deliberately contrived impurity profile could provide all these capabilities. We present an analysis of the detector impurity concentration profiles and their impact on the depletion voltage, capacitance and charge collection times for such detectors.

4:42PM M13.00007 The COBRA Neutrinoless Double Beta Experiment, QIANG LI, Washington University in St. Louis, COBRA COLLABORATION — The COBRA is a proposed experiment to detect neutrinoless double beta decays of the isotope $^{116}$Cd. The COBRA design is based on CZT room temperature solid state detectors. A prototype of the experiment made of 64 1 cm$^3$ detectors is running in the Gran Sasso underground laboratory. In this talk, I will discuss the design of the COBRA prototype experiment and possible designs of a large-scale experiment made of 410 kg of CZT detectors. We are currently evaluating the option to use CZT detector units with 200 micron spatial resolution. Such detectors would make it possible to track the electrons from double beta decays and to distinguish them from certain types of background events.

5:06PM M13.00009 CLEAR: Prospects for a Low Threshold Neutrino Experiment at the Spallation Neutron Source, KATE SCHOLBERG, Duke University — A low-threshold neutrino scattering experiment at a high intensity stopped-pion neutrino source has the potential to measure coherent neutral current neutrino-nucleus elastic scattering. A promising prospect for the measurement of this process is a proposed noble-liquid-based experiment, dubbed CLEAR (Coherent Low Energy A(Nuclear) Recoils), at the Spallation Neutron Source. This talk will describe the CLEAR proposal and its physics reach.

Sunday, April 13, 2008 3:30PM - 5:06PM – Session M14 DNP: Nuclear Structure: Medium Mass Nuclei Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis G

3:30PM M14.00001 The g-factor measurement of the $4^+_1$ state in $^{70}$Zn, G. GÜRDAL, Rutgers University, G. KUMBARTZKI, N. BENZER-KOLLER, B. KRIEGER, Y.Y. SHARON, Rutgers University, D. MÜCHER, Universität zu Köln, K. SPEIDEL, Universität Bonn, R. CASPERSON, V. WERNER, E. WILLIAMS, WNSL, Yale University — The measurement of the g factors of excited nuclear states provide an indication of their microscopic structure since the g factors are very sensitive to the proton and neutron contributions to the wave functions. Recently, g factors of excited states in the even-even stable Zn nuclei were measured. The measured g factors of their $2^+_1$ states were generally in good agreement with the results of shell model calculations as well as with the Z/A value, the characteristic of collective behavior. Also studied were the g factors of some $4^+_1$ states, which are only weakly excited by Coulomb excitation. Possible contributions of $1+1/2$ neutrons to the wave function of the $4^+_1$ states in the Zn isotopes would reduce the g factors of these states. To extend these systematic studies, the $4^+_1$ state of $^{70}$Zn was populated by the Coulomb excitation, on a C target, of a beam of $^{70}$Zn in inverse kinematics, and its g-factor was studied using the Transient Field technique. The $\gamma$ ray transition energies in $^{70}$Zn have some near-degeneracies which make the extraction of the g-factor of $4^+_1$ state difficult. Work supported by the U.S. National Science Foundation, U.S.D.O.E under grant DE-FG02-91ER-40609 and by German BMBF under grant number 06KY2051.
3:42PM M14.00002 Coulomb Excitation of n-rich nuclei along the N = 50 shell closure, E. PADILLA-RODAL, Instituto de Ciencias Nucleares, UNAM, A. GALINDO-URIBARRI, Oak Ridge National Laboratory, J.C. BATCHELDER, Oak Ridge Associated Universities, J.R. BEENE, Oak Ridge National Laboratory, C. BINGHAM, University of Tennessee, B.A. BROWN, Michigan State University, K.B. LAGERGREN, P.E. MUELLER, D.C. RADFORD, D.W. STRACENER, Oak Ridge National Laboratory, J.P. URREGO-BLANCO, University of Tennessee, R.L. VARNER, C.-H. YU, Oak Ridge National Laboratory — Recently, we have been investigating characteristics of nuclear states around the neutron-rich mass A = 80 region [1]. Using the Radioactive Ion Beams (RIBs) produced at HRIBF, we have successfully measured the B(E2) values for 78,90,92 Ge, using Coulomb excitation in inverse kinematics. For the germanium isotopes, these data allow a study of the systematic trend between the subshell N= 40 and N=50 shell. Using the same technique, we have measured the B(E2) value of various nuclei along the N=50 shell including the radioactive nucleus 84Se. This value together with our previously measured 86Ge, and the recent result on 82Zn from ISOLDE [2] are providing basic experimental information needed for a better understanding of the neutron-rich nuclei around A ~ 80. We report the new results and compare with shell model calculations. [1] E. Padilla-Rodal et al., Phys. Rev. Lett. 94 (2005) 122501. [2] J. Van de Walle et al., Phys. Rev. Lett. 99 (2007) 142501.

3:54PM M14.00003 Reinvestigation of direct two-proton radioactivity of 94Ag κ (Jπ = 21+, 6.7 MeV) 1. JOSEPH CERNY, UC Berkeley/LBNL, D.W. LEE, LBNL, K. PERAIARJY, STUK, Finland, D.M. MOLTZ, B.R. BARQUEST, L.E. GROSSMAN, W. JEONG, C.C. JEWETT, UC Berkeley — Both direct one-proton decay and direct two-proton decay of 94Ag from this long-lived (0.4 s) isomeric state have been reported by Mukha et al. in experiments performed with the GSI on-line mass separator [1]. In the former decay, two proton groups with energies of 0.79 and 1.01 MeV were observed, each having a branching ratio of about 2%; in the latter decay, coincident events with a threshold energy of 0.4 MeV and a summed decay energy of 1.9 MeV were observed in coincidence with γ-decays in the 92Rh daughter and were assigned to be coincident protons with a branching ratio of 0.5(3)%. We have recently utilized our helium-jet system at the Berkeley 88-inch cyclotron to repeat this experiment, again employing the 58Ni(12C,pn) reaction at 192 MeV. Reaction products were transported via a capillary to a detection area and collected on a slowly rotating wheel in front of an assembly of 24 ΔEγγ and Eγ detectors with a threshold of 0.4 MeV for identifying protons. The beta-particle background is reduced enough in several of these telescopes to clearly observe the 0.79 MeV single proton decay from 94Ag. Data analysis is continuing and results of the search for coincident, identified protons will be presented. [1] Mukha et al., Nature 439, 298 (2006) and references therein.

1Supported by the U.S. Department of Energy, Office of Nuclear Physics, under Contract No. DE-AC02-05CH11231 (Lawrence Berkeley National Laboratory).

4:06PM M14.00004 Spectroscopy of exotic 123,125Ag produced in fragmentation reactions 1. I. STEFANESCU, University of Maryland, W.B. WALTERS, N. HOTELING, B. TOMLIN, P.F. MANJICA, J. PEREIRA, A. BECERRIL, T. FLECKENSTEIN, A.A. HECHT, G. LORUSO, M. QUINN, J.S. PINTER, J.B. STOKER — We extended the experimental knowledge in the mass-region around 132Sn by identifying the decay of high-spin isotopes in the exotic mass-region 123,125Ag. The two isotopes were produced at the NSCL laboratory by projectile fragmentation of a 136Xe beam at 120MeV/μ directed onto a thick Be target. The NSCL Beta Counting System, was used identify secondary beam fragments. Prompt and delayed gamma-rays following the decay of the fragments were detected with the SEGA array. Partial level schemes for 123,125Ag are proposed for the first time. The observed states show single-particle characteristics, indicating strong Z=50 and N=82 shell gaps and also support the proposed weakened nucleon-nucleon interaction in this mass-region.

1This work was supported in part by the NSF grants PHY-06-06007 (NSCL) and PHY-02-44453 (JINa) and the U.S. Department of Energy, Office of Nuclear Physics, under contracts DE-AC02-06CH11357 (ANL) and DE-FG02-94-ER40834 (Maryland).

4:18PM M14.00005 Nuclear Dipole Response of Bound States in N=82 Nuclei Below Particle Threshold 1. A. TONCHEV, A. HUTCHESON, E. KWAN, G. RUSEV, W. TORNOW, Duke and TUNL, C. ANGELL, S. HAMMOND, H. KARWOSKI, UNC and TUNL, J. KELLEY, NCSU and TUNL — Nuclear resonance fluorescence measurements have been performed on N=82 nuclei using 100% linearly polarized γ-rays at the High-Intensity γ-ray Source (HIγS) at energies below the particle emission threshold. The low-lying dipole excitations have been identified via a γ-particle coincidence setup, and the dipole strength distribution will be compared with microscopic calculations within the framework of the quasiparticle-phonon model.

1This work was supported in part by USDOE Grants No. DE-FG02-97ER41033, DE-FG02-97ER41042, and DE-FG02-97ER41041.

4:30PM M14.00006 Single-particle states outside the N=82 core 1. BENJAMIN KAY, JOHN SCHIFFER, Argonne, SEAN FREMAN, Manchester, JASON CLARK, CATHARINE DEIBEL, ANDREAS HEINZ, ANUJ PARIKH, CHRIS WREDE, Yale — A systematic study of the high-j single-neutron states outside the N=82 isotopes was carried out with the (α, 3He) reaction on 138Ba, 140Ce, 142Nd and 144Sm at a beam energy of 51 MeV. The separation between the 1j3/2 and 3j1/2 single-neutron states, was measured. Smeftoscopic factors for the states populated in the high-f transfers indicate significant fragmentation for the f=5 and f=6 strength, but the summed strengths on these targets are constant. The centroids of the single-particle strength display a change in the relative energies of these two nodeless single-particle orbits, similar to the trend observed in the 50 isotopes. The centroids shifts with neutron number are in agreement with those expected from the monopole term in the tensor component of the residual interaction between nucleons of Otsuka et al.2. This research was supported by the DOE Office of Nuclear Physics under Contract Nos. DE-FG02-91ER40609 and DE-AC02-06CH11357.


4:42PM M14.00007 CENS: A computational environment for nuclear structure, MORTEN HJORTH-JENSEN, GUSTAV R. JANSEN, Department of Physics, University of Oslo, Norway — We present a recently developed software written in Python which merges several Fortran95 and C++ codes for doing `ab initio` nuclear structure calculations. Combined with a pedagogical graphcal user interface, the software allows the user to perform nuclear structure calculations starting from the free-nucleon-nucleon interaction, and via various renormalization techniques one obtains an effective interaction for shell-model calculations. The included shell-model code allow the user to compute spectra and transition probabilities for practically all mass areas. Several methods for renormalizing a nucleus-nucleus interaction and taylor it to specific model spaces are available, ranging from no-core shell-model interaction to interactions derived from many-body perturbation theory.
of the turbulence saturates at about $\delta B/B_{\text{analytical theory}}$. The growth rate of the field perturbations is slower than estimated for nonresonant modes using the quasilinear approach, and the amplitude drift of cosmic-ray ions in the upstream plasma, but show that an oblique filamentary mode grows more rapidly than the nonresonant parallel modes found in the evolution of the magnetic turbulence and its backreaction on cosmic ray trajectories. We confirm the generation of the turbulent magnetic field due to the remnant shocks. The studies aim at testing the predictions of a strong amplification of short-wavelength nonresonant wave modes and at studying the subsequent

Iowa State University — We present results of 3-D Particle-In-Cell simulations of magnetic turbulence production by cosmic-rays drifting upstream of supernova of Supernova Remnant Shocks, MARTIN POHL, Iowa State University, JACEK NIEMIEC, Polish Academy of Sciences, TOM STROMAN, Iowa State University — We present results of 3-D Particle-In-Cell simulations of magnetic turbulence production by cosmic-rays drifting upstream of supernova remnant shocks. The studies aim at testing the predictions of a strong amplification of short-wavelength nonresonant wave modes and at studying the subsequent evolution of the magnetic turbulence and its backreaction on cosmic ray trajectories. We confirm the generation of the turbulent magnetic field due to the drift of cosmic-ray ions in the upstream plasma, but show that an oblique filamentary mode grows more rapidly than the nonresonant parallel modes found in the Newtonian limit of General Relativity as well as in the 3+1 split formalism. It is thought that gravitational waves are driven by oscillations within the superfluid interior and, therefore, may provide a very important source of energy for magnetospheric acceleration processes. Future results will ultimately be compared to realistic spectra from LIGO and VIRGO.

3:42PM M15.00002 The influence of radiation on shocks structure in laboratory astrophysics, MATTHIAS GONZALEZ, Instituto de Fusion Nuclear, Universidad Politecnica de Madrid, Madrid, Spain, EDOUARD AUDIT, CEA Saclay DSM/IRFU/SAp, Gif-sur-Yvette, France, CHANTAL STEHLE, MICHEL BUSQUET, OBSM/LERMA, Meudon, France — Radiative shocks are found in various astrophysical situations such as stellar accretion. Studying such shocks, their topology and thermodynamical properties is the starting point to understand their physical properties. This study is now possible with the recent development of large laser facilities which has therefore given a strong impulse to laboratory astrophysics. We present the main characteristics of radiative shocks obtained in such installations thanks to results obtained in experiments and with our multi-dimensional radiation-hydrodynamics code HERACLES. We focus our discussion on the importance of multi-dimensional radiative transfer effects on the shock topology and dynamics. In particular, the importance of the ratio between the photon mean free path and the transverse extension of the shock, the possibility to achieve radiation-hydrodynamics code HERACLES. We focus our discussion on the importance of multi-dimensional radiative transfer effects on the shock topology and dynamics. In particular, the importance of the ratio between the photon mean free path and the transverse extension of the shock, the possibility to achieve

3:54PM M15.00003 Production of Magnetic Turbulence by Cosmic Rays Drifting Upstream of Supernova Remnant Shocks, MARTIN POHL, Iowa State University, JACEK NIEMIEC, Polish Academy of Sciences, TOM STROMAN, Iowa State University — We present results of 3-D Particle-In-Cell simulations of magnetic turbulence production by cosmic-rays drifting upstream of supernova remnant shocks. The studies aim at testing the predictions of a strong amplification of short-wavelength nonresonant wave modes and at studying the subsequent evolution of the magnetic turbulence and its backreaction on cosmic ray trajectories. We confirm the generation of the turbulent magnetic field due to the drift of cosmic-ray ions in the upstream plasma, but show that an oblique filamentary mode grows more rapidly than the nonresonant parallel modes found in analytical theory. The growth rate of the field perturbations is slower than estimated for nonresonant modes using the quasilinear approach, and the amplitude of the turbulence saturates at about $\delta B/B \sim 1$.

4:06PM M15.00004 ABSTRACT WITHDRAWN

4:18PM M15.00005 Relativistic MHD Jets and Their Interactions with the Intra-cluster Medium: Plasma Physics at its Extreme, HUI LI, MASANORI NAKAMURA, SHENGTAI LI, LANL, HAO XU, LANL/UCSD — We present the formulation of magnetically dominated relativistic MHD flows as a model for extra-galactic jets produced by accretion onto supermassive black holes. Three-dimensional relativistic MHD simulations will be presented on how the energy outflow partitions among different physical components and on how the collimation occurs. We will also examine the stability of such systems. Similar to many of the laboratory plasma systems, current driven instabilities are crucial to jet dynamics, though relativistic velocities and expanding boundaries can significantly change the stability properties. In addition, the interaction between such flows with their environment, e.g., the intra-cluster medium, will be studied. 3-D instabilities that lead to flux conversion seem to be necessary for both the jet stability and the radio lobe formation. Simulations are compared with observations of X-ray cavities in clusters and the possibility of lobes being magnetically dominated on global scales will be discussed. We incorporate such models as AGNs in large scale cosmological cluster formation simulations to study the AGN feedbacks on structure formation. The morphology and properties of jet-lobe systems in realistic cluster simulations will be presented.

4:30PM M15.00006 X-ray emission from charge-exchange: An astrophysical plasma diagnostic tool, THOMAS CRAVENS, INA ROBERTSON, University of Kansas, STEVEN SNOWDEN, MICHAEL COLLIER, NASA Goddard Spaceflight Center, KIP KUNTZ, John Hopkins University, MIKHAIL MEDVEDEV, University of Kansas, KENNETH HANSEN, University of Michigan — Astrophysical x-rays typically come from hot collisional plasmas, such as the solar corona or supernova remnants. However, x-rays can also be produced in cooler gas by charge exchange (CX) collisions between neutrals and highly-charged ions. The CX mechanism applied to the solar wind has been shown to generate x-ray emission at comets, in the terrestrial magnetosheath, and throughout the heliosphere (where the solar wind interacts with incoming interstellar neutral gas). Heliospheric emission is thought to make a significant contribution to the observed soft x-ray background (SXR). Efforts are underway to distinguish this contribution from emission due to hot interstellar gas and the galactic halo. X-rays from CX could provide diagnostic information (e.g., line ratios) on regions where hot astrophysical plasma comes into contact with neutral gas.
4:25PM M15.00001 X-ray diffraction from shocked materials: investigating solid-solid phase transitions, JUSTIN WARK, University of Oxford — X-ray diffraction on nanosecond and sub-nanosecond time-scales has proven to be a useful tool in investigating the transient response of shocked crystals. Perhaps the most notable success in this area has been the direct observation of the α → c transition in laser-shocked single crystals of [001] iron. [1,2] The information extracted from the diffraction patterns has been shown to be in remarkable agreement with multi-million atom molecular dynamics calculations. [3] Having successfully observed the transition in single crystals shocked along the principal axis, several further challenges remain. Amongst these are the exploration of the response of single crystals to shocks propagating along other crystallographic directions (where significantly different response is predicted [4]) the role of pre-existing defects in the time-scale of the elastic/plastic response of the material, and any differences that may occur in polycrystalline compared with single crystal samples.[5] A further challenge will be the development of rapid compression techniques that take samples to off-Hugoniot states (for example so-called quasi-isentropic compression). If such states can be produced in a controlled way, much could potentially be learnt about the state of certain planetary cores, including our own. [1] D.H. Kalantar, J.F. Belak, G.W. Collins, J.D. Colvin, H.M. Davies, J.H. Eggert, T.C. Germann, J. Hawreliak, B.L. Holian, K. Kadau, P.S. Lomdahl, R.C. Albers, R.C. J.S. Wark, A. Higginbotham, and B.L. Holian, F. O, N, C) indicates the 10- to 50-Mbar shock wave has transited an Al layer buried in a CH target, while evidence of even higher charge states indicates the arrival of the heat front. Simulations of the shock heating and heat-front penetration, performed with the 1-D hydrodynamics code LILAC (formerly Adam’s Mark Hotel), Promenade F.

4:25PM M15.00007 Effects of Electron Self-Force on Superstrong Laser Pulse, NATALIA M. NAUMOVA, Laboratoire d’Optique Appliquée, UMR 7639 ENSTA, Ecole Polytechnique, CNRS, 91761 Palaiseau, France, IGOR V. SOKOLOV, Space Physics Research Laboratory, University of Michigan, Ann Arbor, MI 48109, VICTOR P. YANOFSKY, JOHN A. NEE, Center for Ultrafast Optical Science and FOCUS Center, University of Michigan, Ann Arbor, MI 48109, GERARD A. MOUROU, Laboratoire d’Optique Appliquée, UMR 7639 ENSTA, Ecole Polytechnique, CNRS, 91761 Palaiseau, France — We analyze the effect of self-force on a single electron and on plasma electrons giving attention to the electromagnetic energy generated by an accelerated motion in a field of a relativistically strong electromagnetic wave. The effect is essential if the scattered energy is comparable with the rest-mass energy of the electron in the frame of reference where the electron was initially at rest. We develop a method for solving the Lorentz-Abraham-Dirac equation and accounting for radiation in a self-consistent manner. The solution is then applied to the interactions of super-strong laser fields with an electron and a plasma layer including the presence of strong charge separation fields. This scheme allows a simulation of resulting radiation with spatial and spectral distributions. We consider a conversion efficiency of incident radiation to γ-ray emission at intensities of 10^{52} - 10^{54} W/cm^2.

4:42PM M15.00008 A Self-Consistent Description of Dust Interactions in Space and Nano-structured Plasmas, STEVEN BEKHOR, Michigan Plasma Physics Research Institute — The effect of nano/micro-structures and dust voids on the dispersion relations and the overall dynamics of plasma waves has numerous applications in the study of laboratory and space plasmas such as planetary rings and lunar and asteroidal dust. In particular, elastic Coulomb collisions with dust particles and charging interactions affect the overall particle balance of the plasma species and must be investigated self-consistently. Furthermore, in the low-frequency limit, a comprehensive theory must account for the dynamics of both electrons as well as ions, especially in strongly collisional regimes where the use of the full Braginski equations is warranted. In the current treatment, rings and lunar and asteroidal dust. In particular, elastic Coulomb collisions with dust particles and charging interactions affect the overall particle balance of the plasma species and must be investigated self-consistently. Furthermore, in the low-frequency limit, a comprehensive theory must account for the dynamics of both electrons as well as ions, especially in strongly collisional regimes where the use of the full Braginski equations is warranted. In the current treatment, the fluid equations are developed to address a large class of problems involving space plasmas and nanofabrication. It so happens that dust charging results in a new channel of power dissipation that may explain numerous phenomena in such complex self-organized thermodynamically open systems. Numerous examples are presented and the stage is set for future numerical efforts.

5:06PM M15.00009 ABSTRACT WITHDRAWN —

Sunday, April 13, 2008 4:25PM - 5:15PM —
Session 12HE HEDP HEDLA: Laboratory Studies of Dense Matter I Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade F

4:25PM 12HE.00001 X-ray diffraction from shocked materials: investigating solid-solid phase transitions, JUSTIN WARK, University of Oxford — X-ray diffraction on nanosecond and sub-nanosecond time-scales has proven to be a useful tool in investigating the transient response of shocked crystals. Perhaps the most notable success in this area has been the direct observation of the α → c transition in laser-shocked single crystals of [001] iron. [1,2] The information extracted from the diffraction patterns has been shown to be in remarkable agreement with multi-million atom molecular dynamics calculations. [3] Having successfully observed the transition in single crystals shocked along the principal axis, several further challenges remain. Amongst these are the exploration of the response of single crystals to shocks propagating along other crystallographic directions (where significantly different response is predicted [4]) the role of pre-existing defects in the time-scale of the elastic/plastic response of the material, and any differences that may occur in polycrystalline compared with single crystal samples.[5] A further challenge will be the development of rapid compression techniques that take samples to off-Hugoniot states (for example so-called quasi-isentropic compression). If such states can be produced in a controlled way, much could potentially be learnt about the state of certain planetary cores, including our own. [1] D.H. Kalantar, J.F. Belak, G.W. Collins, J.D. Colvin, H.M. Davies, J.H. Eggert, T.C. Germann, J. Hawreliak, B.L. Holian, K. Kadau, P.S. Lomdahl, R.C. Albers, R.C. J.S. Wark, A. Higginbotham, and B.L. Holian, F. O, N, C) indicates the 10- to 50-Mbar shock wave has transited an Al layer buried in a CH target, while evidence of even higher charge states indicates the arrival of the heat front. Simulations of the shock heating and heat-front penetration, performed with the 1-D hydrodynamics code LILAC (formerly Adam’s Mark Hotel), Promenade F.

4:50PM 12HE.00002 Creating and probing matter compressed and heated by shock waves on OMEGA, SEAN REGAN, Laboratory for Laser-Energetics, University of Rochester — A physical understanding of the energy transport from the laser-deposition region to the target is required for many Laser-driven, high-energy-density experiments and to achieve energy gain with inertial confinement fusion. Direct-drive target-physics experiments are initiated by the ablation of material from the outside surface of the target with intense laser beams. The ablated shell mass forms a coronal plasma that can accelerate the target via the rocket effect. Laser absorption occurs in the underdense corona via inverse bremsstrahlung and the energy is transported by electrons to the ablation surface. The ablation process launches shock waves into the target that set the target on the desired isentrope. Using a planar target geometry, time-resolved Al 1s→2p absorption spectroscopy is used to probe shock-heated and compressed matter on OMEGA. The measured Al absorption spectra were modeled with the atomic physics code PrismSPECT [Prism Computational Sciences, Inc., Madison, WI 53711] to infer the T_e and n_e of the nearly Fermi-degenerate matter (T_e ~ 10 to 30 eV, n_e ~ 1 to 6 × 10^{23} cm^{-3}). Detection of low charge states (i.e., F, O, N, C) indicates the 10- to 50-Mbar shock wave has transited an Al layer buried in a CH target, while evidence of even higher charge states indicates the arrival of the heat front. Simulations of the shock heating and heat-front penetration, performed with the 1-D hydrodynamics code LILAC [J. Delettrez et al., Phys. Rev. A 36, 3926 (1987)] using a nonlocal transport model, are close to the measured results. This work was supported by the U.S. Department of Energy Office of Inertial Confinement Fusion under Cooperative Agreement No. DE-FC52-08NA28302. *In collaboration with H. Sawada, D. D. Meyerhofer, P. B. Radha, J. A. Delettrez, R. Epstein, V. N. Goncharov, D. Li, V. A. Smalyuk, T. C. Sangster, and B. Yaakobi, UR/LLE; R. C. Mancini, UNR

Sunday, April 13, 2008 5:30PM - 7:00PM —
Session N1 APS: APS Awards Presentations, Past-President’s Address and Lilienfeld Prize Talk Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade C

5:30PM N1.00001 Awards Presentation —

6:00PM N1.00002 Past-President’s Address: APS, Physics: Aspirations and Goals, LEO KADANOFF, APS Past-President, University of Chicago —
6:30PM N1.00003 Lilienfeld Prize Talk: New Results on Water in Bulk, Nanoconfined, and Biological Environments, H. EUGENE STANLEY, Department of Physics, Boston University — This talk will introduce some of the 63 unsolved mysteries of water, and will demonstrate some recent progress in solving them combining information provided by water in bulk, nanoconfined, and biological environments. In particular, we will present evidence from experiments designed to test the hypothesis that water displays “polymorphism” in that it can exist in two liquid different phases and display a novel liquid-liquid critical point. The concept of liquid polymorphism is also proving useful in understanding some of the anomalies of other liquids with local tetrahedral symmetry, such as silicon, silica, and carbon. In particular, the talk will discuss changes in dynamic transport properties [1], and water in biological environments, including a possible physical explanation for the protein glass transition [2].


Monday, April 14, 2008 8:30AM - 10:18AM
Session Q1 APS: Plenary Session II Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis DE

8:30AM Q1.00001 The Kavli Foundation Lectureship: The Double Pulsar: A Unique Gravity Laboratory, MICHAEL KRAMER, University of Manchester, Jodrell Bank Centre for Astrophysics — Ever since their discovery, pulsars have been used as precise cosmic clocks. Their observations in binary systems take us beyond the weak-field regime of the solar-system in the study of theories of gravity. Their contribution is crucial as no test should be considered as complete without probing the strong-field realm of gravitational physics by finding and timing pulsars. This is particularly highlighted by the discovery of the first double pulsar system which is unique in that both neutron stars are detectable as radio pulsars. This, combined with significantly higher mean orbital velocities and accelerations when compared to other binary pulsars, provides the best available testbed for general relativity and alternative theories of gravity in the strong-field regime to date. This review presents the plethora of relativistic phenomena observable in this fascinating system and gives an up-to-date report on its exploitation as a gravity lab.

9:06AM Q1.00002 Dark Matter in the Cosmos and in the Laboratory, MICHAEL E. PESKIN, Stanford Linear Accelerator Center, Stanford University — 80% of the matter in the universe is “dark matter,” a neutral, diffuse, and weakly-interacting material made of an unknown elementary particle. In this colloquium, I will explain how we know this, and how we might try to directly observe dark matter particles in the galaxy. I will then examine dark matter from a particle physicist’s viewpoint and explain how we will use data from high-energy particle colliders to discover and identify the dark matter particle.

9:42AM Q1.00003 High Temperature Superconductivity 20 Years Later: Achievements, Promises and Challenges, C.W. CHU, University of Houston, Hong Kong University of Science and Technology and Lawrence Berkeley Laboratory — The discovery of high temperature superconductivity (HTS) 20 years ago has been hailed as one of the major advancements in modern science with great promises. In this presentation, I shall first briefly recall the seminal observation of superconductivity at 35 K in early 1986 and several episodes leading to the discovery of superconductivity at 93 K in early 1987. I shall then summarize the progress that has been made in the ensuing 20 years in the areas of HTS science, materials, and applications. Finally, challenges to realize the full promises of HTS technology will be discussed and steps to meet the challenges proposed.

Monday, April 14, 2008 10:45AM - 12:33PM
Session R2 DPF: American Particle Physics in the Coming Era I Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis D

10:45AM R2.00001 The U.S. Role in the LHC Program, ABRAHAM SEIDEN, University of Calif. at Santa Cruz — The start of the LHC physics program will initiate the long anticipated chance to explore physics at the TeV mass scale. In collaboration with scientists across the globe, opportunities will exist for U.S. physicists to attack some of the most pressing physics questions of the field as well as break new ground in areas such as computing and detector development for very high luminosity data collection at an upgraded LHC. I will review a number of these exciting opportunities.

11:21AM R2.00002 The U.S. Role in the Global ILC Effort, MICHAEL HARRISON, Brookhaven National Laboratory — An e-+e- Linear Collider in a similar center-of-mass energy range to the LHC was affirmed by the world community in 1997 (HEPAP, ECFA, & ALCFA) as the consensus next global HEP facility. With the ICFA decision in 2004 to adopt a superconducting approach to the RF technology of such a machine the Global Design Effort (GDE) was launched to produce a conceptual reference design and associated cost estimate. This design work also indicated the critical RD milestones that needed to be demonstrated before the ILC could be credibly proposed to the various funding agencies. This talk will review the global R&D program and the role of the U.S. within these activities. Recent funding decisions in the U.K. and the U.S. have impacted these efforts and the current status will be outlined. A snapshot of the detector R&D program will also be given.

11:57AM R2.00003 Flavor Physics in the Coming Era, ROBERT TSCHIRHART, Fermi National Accelerator Laboratory — Decades of intense experimental and theoretical effort in flavor physics has established a foundation from which incisive probes of physics beyond the Standard Model can be performed. Our most compelling theories of “Terascale” (TeV energy scale) physics typically predict new contributions to flavor-violating processes involving quarks. Many of these predictions are expected to have flavor-violating and CP-violating couplings. The rich program of experiments at B factories and elsewhere have unexpectedly found no clear signals of such contributions, which in turn tightly constrains the space for new physics. The “Minimal Flavor Violating” world we find ourselves in motivates a new program of precision experiments that can build on the strong theoretical foundation that exists today in flavor physics. This lecture will review where precision flavor experiments at the “Intensity Frontier” are at today and what the prospects are for advancing probes of new physics through precision experiments at next-generation Intensity Frontier facilities.

Monday, April 14, 2008 10:45AM - 12:33PM
Session R3 DNP: Neutron Rich Nuclei in the Laboratory and in the Cosmos Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis E
10:45AM R3.00001 Observing the signatures of the r-process in metal-poor stars1, ANNA FREBEL, McDonald Observatory, University of Texas at Austin — In their atmospheres, old metal-poor Galactic stars retain detailed information about the chemical composition of the interstellar medium at the time of their birth. Extracting such stellar abundances enables us to reconstruct the beginning of the chemical evolution shortly after the Big Bang. About 5% of metal-poor stars with [Fe/H] < -2.5 display in their spectrum a strong enhancement of neutron-capture elements associated with the rapid (r) nucleosynthesis process that is responsible for the production of the heaviest elements in the Universe. This fortiety provides a unique opportunity of bringing together astrophysics and nuclear physics because these objects act as “cosmic lab” for both fields of study. The so-called r-process stars are thought to have formed from material enriched in heavy neutron-capture elements that were created during an r-process event in a previous generation SN. It appears that the few stars known with this rare chemical signature all follow the scaled solar r-process pattern (for the heaviest elements with 56 < Z < 90 that is). This suggests that the r-process is universal – a surprising empirical finding and a solid result that can not be obtained from any laboratory on earth. It is thus a crucial constraint for theoretical nuclear physics models. Among the heaviest elements are the long-lived radioactive isotopes 232Th (half-life 14 Gyr) and 238U (4.5 Gyr). While Th is often detectable in these stars, U poses a real challenge because only one, extremely weak line is available in the optical spectrum. In comparison with stable r-process nuclei, such as Eu, stellar ages can be derived from abundance ratios involving Th and/or U. Through individual age measurements, these objects become vital probes for observational “near-field” cosmology by providing an independent lower limit for the age of the Universe.

1Support through the W. J. McDonald Fellowship is gratefully acknowledged

11:21AM R3.00002 New Views of the r-Process, YONG-ZHONG QIAN, University of Minnesota — Nucleosynthesis via rapid neutron capture, the r-process, is responsible for approximately half of the solar abundances of the nuclei with mass numbers A > 100. Five decades after this process was proposed, two outstanding issues remain: (1) which astrophysical environments can provide the physical conditions required for the r-process? and (2) what is the detailed nuclear physics input that governs the yield pattern of nuclei from an r-process? Both issues are crucial for a full understanding of the r-process. This talk will mainly address the issue of the astrophysical sites. While there are no self-consistent models that can produce a robust r-process, observations of elemental abundances in old stars of the Galactic halo over the past decade have provided important guidance to the overall nucleosynthetic characteristics of astrophysical r-process sources. For example, these observations strongly suggest that the source for the heaviest r-process nuclei produces none or very little of the Fe group and lighter nuclei. On the theoretical front, several new mechanisms other than rapid (r) or slow (s) neutron capture were found to produce the nuclei with 60 < Z < 100 that were thought to be made dominantly by the r and s-processes. Major results from the stellar observations will be highlighted. Their implications for astrophysical models of the r-process will be discussed. Existing models and possible improvements will be reviewed based on the observational implications.

11:57AM R3.00003 Discovery of 40Mg and 42Al1, THOMAS BAUMANN, NSCL, Michigan State University, East Lansing, MI 48824-1321 — Although very neutron rich nuclei do not exist on earth due to their short lifetimes, they do exist in the cosmos where conditions are met that can produce them. This is the case in the crust of accreting neutron stars, where the high gravitational pressure causes electron capture reactions that form neutron rich nuclei up to the drip line. They also can be formed and detected in the laboratory. The neutron rich nuclei 40Mg and 42Al have now been observed for the first time. While 40Mg has long been predicted by many leading nuclear models to be particle bound, the odd-odd neighbor 42Al was believed to be unbound until now. The discovery was made at the National Superconducting Cyclotron Laboratory, where a primary beam of 40Ca was fragmented on a tungsten target and the very rarely formed isotopes of 40Mg and 42Al, among others, were separated and identified in flight using a two-stage fragment separator. The findings in the laboratory have a direct impact on our knowledge about the cosmos, for these isotopes now have to be included in the composition of the crust of accreting neutron stars. This might have an effect on the crust heating which influences the rate of X-ray superbursts1 for which only recently data has become available. The new discoveries are also consequential for theoretical mass predictions, where the uncertainties are still too large for astrophysical applications. Current global mass models differ significantly in the prediction of the neutron drip line in this region. The comparison of the observed isotopes—especially the odd-odd 42Al—to established theoretical model calculations suggests that the drip line lies further out to heavier isotopes.

1Supported by the National Science Foundation under grant PHY-06-06007

Monday, April 14, 2008 10:45AM - 1:09PM —
Session R4 CSWP: Building a Successful Career: Perseverance, Funding & Climate
Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade B

10:45AM R4.00001 Tackling Our Energy Challenges in a New Era of Science, HARRIET KUNG, Office of Science, U.S. Department of Energy — In this presentation, Dr. Kung will give an overview of the BES program, which supports basic research in materials sciences, chemistry, geosciences, and biosciences, as well as the construction and operation of nearly two dozen major scientific user facilities, including the nation’s large synchrotron radiation-light sources, neutron-scattering facilities, electron beam microscopy centers, and nanoscale science research centers. In February 2008, BES announces the initiation of Energy Frontier Research Centers (EFRCs) to accelerate the rate of scientific breakthroughs needed to create advanced energy technologies for the 21st century. The EFRCs will pursue the fundamental understanding necessary to meet the global need for abundant, clean, and economical energy. It is anticipated that approximately $100 million will be available for multiple EFRC awards in FY 2009. Information about the EFRCs and funding opportunities for single PI and small group awards will be discussed in the presentation. For additional information, visit the BES Web page at: http://www.sc.doe.gov/bes/bes.html

11:21AM R4.00002 Challenges and opportunities in a Physics Career, PERSIS DRELL, Stanford and SLAC — No abstract available.

11:57AM R4.00003 A Career in Science and Technology Management, CHERRY MURRAY, Lawrence Livermore National Lab — I will describe what it takes to be a successful “scientist-manager” and the challenges and potential road blocks to enjoyment of such a career, especially for women.
Monday, April 14, 2008 10:45AM - 12:33PM –
Session R6 FHP: 80 Years of Quantum Mechanics: A New International Project  
Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade D

10:45AM R6.00001 Van Vleck and Slater: Two Americans on the Road to Matrix Mechanics  
MICHEL JANSSSEN, University of Minnesota — I relate the story of how matrix mechanics grew out of the treatment of optical dispersion in the old quantum theory, paying special attention to the contributions of the American theoretical physicists John H. Van Vleck and John C. Slater. Van Vleck shares the credit with Max Born for having been the first to publish a full derivation of the crucial Kramers dispersion formula using Bohr’s correspondence principle. Slater was one of the architects of the short-lived but influential Bohr-Kramers-Slater (BKS) theory that helped popularize the so-called Ersatz- or virtual oscillators central both to the treatment of dispersion in the old quantum theory and to the transition to matrix mechanics.
11:21AM R6.00002 Creative Confusion. Quantum Theory on the Way to Wave Mechanics. CHRISTOPH LEHNER, Max Planck Institute for the History of Science, Berlin — When wave mechanics was formulated by de Broglie and Schrödinger in the mid-twentieth, there was practically no empirical evidence for wave-like behavior of matter. What then were the motivations for pursuing an idea that was rather at odds with the discontinuity that quantum theory seemed to demand? Paradoxically, they can be found in the attempts to understand the quantum nature of light, for which just at that time empirical evidence could not be ignored anymore. In my talk, I will argue that “wave-particle duality” was initially nothing more than a confusion of competing theoretical explanations. It was in statistical mechanics where this idea first took on a more concrete form of a symmetry of two different theoretical explanations. And it was statistical mechanics that allowed this model of dual explanations to be transferred to the theory of matter. This transfer culminated in Schrödinger’s paper of December 1925 “On Einstein’s Gas Theory,” which explicitly used the symmetry of explanations to motivate a wave theory of matter. It is here that Schrödinger’s equivalent to Heisenberg’s “Umdeutung” (reinterpretation) of mechanical quantities is to be found, not in his more famous 1926 papers on atomic theory.

11:57AM R6.00003 ”Knabenphysik”: The birth of quantum mechanics from a postdoctoral viewpoint. ALEKSI KOJEVNIKOV, University of British Columbia — No abstract available.

Monday, April 14, 2008 10:45AM - 12:33PM – Session R8 DAP: Cosmology / Early Universe Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel, Promenade A

10:45AM R8.00001 Fundamental physics from the cosmological 21 cm radiation1, RISHI KHATRI, BENJAMIN WANDELT, University of Illinois at Urbana-Champaign — New low frequency radio telescopes currently being built open up the possibility of observing the 21 cm radiation before the Epoch of Reionization in the future, in particular at redshifts $\sim 30 < z < 200$, also known as the dark ages. At these high redshifts, Cosmic Microwave Background (CMB) radiation is absorbed by neutral hydrogen at its 21 cm hyperfine transition. This redshifted 21 cm signal thus carries information about the state of the early Universe and can be used to test fundamental physics. We study two types of new physics which such observations can constrain. 1) We show that the 21 cm radiation is very sensitive to the variations in the fine structure constant and can in principle place constraints comparable to or better than the other astrophysical experiments. 2) Cosmic strings, if they exist, contribute to the anisotropies in the primordial gas leaving an imprint on the 21 cm radiation. We show that the 21 cm radiation can probe the entire parameter space predicted by the brane-inflation scenarios of superstring theory. Making such observations will require radio telescopes of collecting area $10^2 - 10^6$ km$^2$ compared to $\sim 1$ km$^2$ of current telescopes.

1Part of this work was done at Max Planck Institute for Astrophysics. BW acknowledges support by the Alexander von Humboldt foundation.

10:57AM R8.00002 The evolution of cosmic structure with coupled dark matter and dark energy. PAUL SUTTER, PAUL RICKER, Univ of Illinois - Urbana — We examine how coupled dark matter and dark energy modify the development of structure in the universe. Specifically, we study how the various effects of these theories, such as a fifth force in the dark sector and a modified particle Hubble drag, produce variations in the redshifts of caustic formation and the present-day density profiles of Zel’dovich pancakes. We compare our results in direct simulation to a perturbation theory approach for the dark energy scalar field. We also examine whether models that have been tuned to match the constraints of current observations can produce new observable effects in the nonlinear structure of pancakes. Our results suggest that a fully realistic three-dimensional simulation will produce significant new observable features, such as modifications to the mass function and halo radial density profile shapes, that can be used to distinguish these models from standard concordance cosmology and from each other.

11:09AM R8.00003 Effects of structure formation on the apparent expansion rate of the universe1, XINGHAI ZHAO, GRANT MATTHEWS, IN-SAENG SUH, University of Notre Dame — There are recent claims that back-reaction terms arise when the effective Friedmann equation is averaged over a spatial volume in a locally inhomogeneous cosmology. These terms are claimed to lead to a new expansion rate of the universe. Many analytical methods for this averaging procedure have been proposed and investigated. In this talk, we discuss a numerical simulation approach in which we have derived a scheme to include general relativistic corrections for general three dimensional inhomogeneities in space. The volume averaged expansion rate is quantitatively calculated with an N-body simulation code for a matter dominated, structure forming era. We discuss current limits on the corrections to the standard expansion rate. The possible physical nature of the corrections and the impacts of this averaging on the cosmological observables will also be addressed.

1Work at Notre Dame is supported by U.S. Department of Energy Grant DE-FG02-95-ER40934

11:21AM R8.00004 Large Scale Structure as a Probe of Gravitational Slip. SCOTT DANIEL, ROBERT CALDWELL, Dartmouth College, ASANTHA COORAY, University of California, Irvine, ALESSANDRO MELCHIORRI, University of Rome — Many modified gravity schemes predict a non-zero difference (“gravitational slip”) between the Newtonian and longitudinal perturbed metric potentials. Such a slip would affect the growth of large scale structure without altering the expansion history of the universe. We quantify the slip with a new parameter $\omega$, show the effect of non-zero $\omega$ on the growth of cosmic overdensities, and constrain its value using CMB and weak lensing data.

11:33AM R8.00005 Study of the Spectrum of Inflaton Fluctuations. MATTHEW GLENZ, LEONARD PARKER, University of Wisconsin-Milwaukee — We examine the spectrum of inflaton fluctuations resulting from a long period of inflation. Our objective is to determine the spectrum in a way that does not depend on regularization of the quantized inflaton fluctuations in curved spacetime. We summarize our results for the spectrum and its scale independence, and compare them to earlier results for the spectrum.

11:45AM R8.00006 Weak Gravitational Lensing Poisson Equation. THOMAS KLING, Bridgewater State College — To date, the observed gravitational shear has been related to the inferred projected mass density of the lens by an integral equation. Alternately, one can relate the observed shear to the gravitational potential by a partial differential equation. Using the Bianchi identity in the Newman Penrose spin coefficient formalism, we derive a new Poisson equation for the mass density where the source term is derivatives of the weak lensing shear. We examine the feasibility of integrating this Poisson equation for wide field ground based and space based telescopes.
11:57AM R8.00007 The Dark Side of Galactic Formation, JAMES BEICHLER, West Virginia Univ at Parkersburg — Dark Matter and Dark Energy are both regarded as anomalies that must be solved by science. Each anomaly is being independently studied while numerous solutions are being suggested for each independent of the other. However, everyone either accepts or assumes that both anomalies must eventually conform to a single common solution. With a little imagination that single solution is not that hard to find. By assuming a real macroscopically extended fifth dimension, characterized by the extrinsic curvature of the four-dimensional portion of that space-time continuum, both DM and DE can be explained in a single model. CDH halos are a simple product of galactic formation and the DE that acts as a negative pressure to increase the speed of light. The old and mature age of spiral galaxies. The extrinsic curvature of four-dimensional space-time, which is completely compatible with both general relativity and Kaluza’s unification of general relativity and electromagnetism, can be identified directly with all forms of DM and DE. This model thus offers a starting point for the unification of relativity and the quantum.

12:09PM R8.00008 On the Geocentric Nature of the Big Bang Theory, LING JUN WANG, University of Tennessee at Chattanooga — To defend the Big Bang Theory (BBT) from falling into a geocentric theory, it is argued that if the universe is expanding linearly from the singularity, the heavenly bodies would appear to be leaving away from each other with isotropic velocity distribution with respect to any observer. In this presentation we will prove rigorously with both classical and relativistic analysis that even strict linearity of Hubble’s law would not save the Big Bang from falling into a geocentric theory. The key of the analysis rests on the two crucial necessary conditions for the raisin-pudding model: 1) The velocities and the positions of the earth and the galaxies must be measured simultaneously; 2) The velocity transformation between the reference frame of the earth and that of the singularity must be linear. The first condition can not be satisfied due to the speed limit of light; and the second condition can not be satisfied due to non-linear velocity transformation of relativity. The whole problem is originated from the Doppler shift explanation of the red shift. Wang’s Dispersive Extinction Theory (DET), however, interprets the red shift as being caused by the dispersive extinction of the star light by the space medium, and therefore does not lead to a geocentric universe. This lends a strong support to DET over BBT.

12:21PM R8.00009 Hot Young Solution to Faint Sun and Supernova Problems, LOUISE RIOFRO, Galileo Inc. — Results from three independent experiments involving the speed of light are presented. Luminosity of Type Ia supernovae depend upon constant fundamental parameters. Accurate measurements of c provide a valuable check on “dark energy” theories. One Theory states that scale R of Space/Time is related to age t by R = ct. Gravitation then requires that GM = tc^2. These expressions provide a simple solution to Einstein-Friedmann equations with k=0. Predicted change in c provides a close fit to observations of Type Ia supernova redshifts. The “Faint Young Sun” has been a paradox of astrophysics. According to standard models, when Earth was forming solar luminosity was only 75% of today’s value. Geology and the fossil record indicate that the Sun turns fuel to energy according to E=mc^2, change in c precisely accounts for the difference. If c had not changed in the amounts predicted, life would not have evolved on Earth. The Lunar Laser Ranging Experiment from 1969 measures the Moon’s recession at 3.82 cm/yr, anomalously high. Geological evidence states that average recession is only 2.9 cm/yr. Change in c precisely accounts for the anomaly, indicating that c changes to this day. Corroborating evidence from three truly independent experiments distinguishes Theory from other DE models. Since M = R = t (Planck Units) leads to predictions not epicycles, Theory should be considered as an alternative to more cumbersome ideas.

Monday, April 14, 2008 10:45AM - 12:33PM — Session R9 DCOMP: Lattice QCD in Elementary Particle Physics

10:45AM R9.00001 Simulations of QCD with Staggered Quarks: Results and Issues, CLAUDE BERNARD, Washington University, St. Louis — I describe recent advances in simulating QCD using the staggered quark action. Current results from the MILC collaboration on the physics of light pseudoscalars (pion and kaon decay constants, V_{us}, quark masses, and low energy constants) are presented, as are results from the Fermilab/MILC collaboration on lepton decay constants and semileptonic form factors of the B and D systems. In addition, I detail the progress that has recently been made in putting staggered QCD simulations on a firmer theoretical footing, in particular by understanding the so-called “rooting trick” and the corresponding chiral effective theory.

11:21AM R9.00002 Testing the Standard Model in the quark flavor sector using lattice QCD, RUTH VAN DE WATER, Fermilab — Recent advances in both computers and algorithms now allow realistic calculations of Quantum Chromodynamics (QCD) interactions using the numerical technique of lattice QCD. The methods used in so-called “2+1 flavor” lattice calculations have been verified both by postdictions of quantities that were already experimentally well-known and by predictions that occurred before the relevant experimental determinations were sufficiently precise. This suggests that the sources of systematic error in lattice calculations are under control, and that lattice QCD can now be reliably used to calculate those weak matrix elements that cannot be measured experimentally but are necessary to interpret the results of many high-energy physics experiments. These same calculations also allow stringent tests of the Standard Model of particle physics, and may therefore lead to the discovery of new physics in the future.

11:57AM R9.00003 The removal of critical slowing down in lattice QCD1, MICHAEL CLARK, Boston University — The quark mass dependence of the computational cost in lattice QCD has proven to be a major obstacle against realistic calculation. I present recent progress in this area, specifically, a new multigrid algorithm which essentially removes this mass dependence.

1This work was supported under NSF Grant No. PHY-0427646.

Monday, April 14, 2008 10:45AM - 12:21PM — Session R10 GGR: Topics in Numerical Relativity

10:45AM R10.00001 Magnetic field effects on gravitational waves from binary neutron stars, MATTHEW ANDERSON, ERIC HIRSCHMANN, Brigham Young University, LUIS LEHNER, Louisiana State University, STEVEN LIEBLING, Long Island University, PATRICK MOTL, Louisiana State University, DAVID NEILSEN, Brigham Young University, CARLOS PALENZUELA, Albert Einstein Institute, JOEL TOHLINE, Louisiana State University — Observational evidence indicates that a fair number of neutron star binaries and neutron star-black hole binaries have a sizable magnetic field which can be responsible for powering pulsars and collimating jets. Magnetic field effects additionally can have a strong influence on the dynamics of the fluid by redistributing angular momentum through different mechanisms (magnetic winding and braking, magneto-rotational instabilities) depending on the strength of the magnetic field and the typical time scales involved in the process. These processes can affect the multipolar structure of the source and consequently the produced gravitational wave. We present results of neutron star binary mergers both with and without magnetic field and discuss the magnetic effects on the gravitational waves, fluid structure, and merger timescale.
10:57AM R10.00002 Relativistic Radiation Magnetohydrodynamics in Dynamical Spacetimes. BRIAN FARRIS, TSZ KA LI, YUK TUNG LIU, STUART SHAPIRO, University of Illinois at Urbana-Champaign — Many systems of current interest in relativistic astrophysics require a knowledge of radiative transfer in a magnetized fluid evolving in a strongly-curved, dynamical spacetime. Such systems include stellar core collapse, GRBs, binary NSNS and BHNS mergers, etc. To model these phenomena, all of which involve general relativity, radiation (either photons and/or neutrinos), and magnetohydrodynamics, we have developed a general relativistic code capable of evolving MHD fluids and radiation fields in dynamical spacetimes. Our code solves the coupled Einstein-Maxwell-MHD-Radiation system of equations both in axisymmetry and in full 3 + 1 dimensions. We evolve the metric by integrating the BSSN equations, and use an algorithm that accounts for both the MHD and radiation moment equations. For our initial study, we treat optically thick gases and assume grey-body opacities. We perform a suite of tests to verify our code. In this talk, we summarize tests involving radiating shocks and nonlinear waves propagating in Minkowski spacetime with planar symmetry.

11:09AM R10.00003 Radiation Magnetohydrodynamics in Dynamical Spacetimes: ‘Thermal’ Oppenheimer-Snyder Collapse. TSZ KA LI, BRIAN FARRIS, YUK TUNG LIU, STUART SHAPIRO, University of Illinois at Urbana-Champaign — We have constructed a new general relativistic code capable of evolving magnetohydrodynamic fluids and radiation fields in a dynamical spacetime. In order to test our code’s ability to handle radiative collapse in a strong-field dynamical spacetime, we simulate the collapse from rest of a spherical dust ball, slightly perturbed by a small fluctuation of thermal radiation. For a sufficiently small perturbation, the matter and metric evolve according to the Oppenheimer-Snyder solution, and the collapsing material propagates according to the general relativistic diffusion approximation. Adopting a grey-body opacity law, and an optically thick medium, we evolve the metric, hydrodynamics and radiation fields self-consistently using our new code. We find good agreement between the numerical result and the analytic solution.

11:21AM R10.00004 Large-scale relativistic simulations in the characteristic approach1, ROBERTO GOMEZ, Pittsburgh Supercomputing Center, WILLIAMS BARRETO, Universidad de Los Andes, Merida, Venezuela, SIMONETTA FRITTELLI, Duquesne University — We report on high-resolution computations in the characteristic approach to numerical relativity, using an extensible, highly scalable computational framework (LEO). A combination of a multi-block decomposition of the sphere (the “cubed sphere”), with spin raising and lowering (“eth”) operators on non-conformal coordinates, and a first order reduction of the Einstein equations is used to obtain a stable, globally second-order accurate numerical method. Applying the framework to a scalar field minimally coupled to gravity in three dimensions, we extract quasi-normal modes, and notice the appearance of energy saturation effects. We analyze the scaling properties of the underlying framework and discuss possible extensions.

1 Supported in part by NSF grants PHY-0135390, PHY-0244752 and PHY-0555218.

11:33AM R10.00005 Close encounters of three black holes1, MANUELA CAMPANELLI, CARLOS LOUSTO, YOSEF ZLOCHOWER, Rochester Institute of Technology — We present the first fully relativistic longterm numerical evolutions of three equal-mass black holes in a hierarchical system consisting of a third black hole in orbit about a black-hole binary at twice the binaries separation. We find that these close-three-black-hole systems can have very different merger dynamics than black-hole binaries. In particular, we see distinctive waveforms, a suppression of the emitted gravitational radiation, and a redistribution of the energy of the system that can impart substantial kicks to one of the members of the binary. We solve two such configurations and find very different behaviors. In one configuration the binary is quickly disrupted and the individual holes follow complicated trajectories and merge with the third hole in rapid succession, while in the other, the binary completes a half-orbit before the initial merger of one of the members with the third black hole, and the resulting two-black-hole system forms a highly elliptical, well separated binary that shows no significant inspiral for (at least) the first 1000M of evolution.

1 We acknowledge NSF support from grants PHY-0722315, PHY-0722703, PHY-0714388, PHY-653303.

11:45AM R10.00006 Small scale structure in the approach to the singularity. DAVID GARFINKLE, Oakland University, FRANS PRETORIUS, WOEI CHET LIM, Princeton University — Numerical simulations are performed of the approach to a general spacetime singularity. In these simulations small scale structure forms on surfaces of codimension 1. The simulations are done with adaptive mesh refinement that resolves the small scale structure. The shape of the small scale structure is compared to an approximate formula for that shape.

11:57AM R10.00007 Numerical Simulations of Oscillations: Excited States in Spherical Symmetry and Ground State Evolutions in 3D. JAYASHREE BALAKRISHNA, Harris-Stowe State University, RUXANDRA BONDARESCU, Cornell University, GREGORY DAUES, NCSA, MIHAI BONDARESCU, AEI — Oscillations are nonsingular solutions of the Einstein-Klein-Gordon equations represented by periodic metric and real field. Using a 1D code we find that spherically symmetric S-branch excited state oscillations are inherently unstable under radial perturbations, the either migrate to the ground state or collapse to black holes. Similar to boson stars higher excited state oscillations cascade through intermediate excited states during their migration to the ground state. Ground state oscillations are then studied with a 3D numerical relativity code based on the Cactus Computational Toolkit. Finding the appropriate gauge condition for the dynamic oscillations is challenging. Slicing conditions are explored and a customized gauge condition is implemented. The behavior of these stars under small nonradial perturbations is studied and gravitational waveforms are extracted. The gravitational waves damp on a short timescale, enabling us to obtain the complete waveform. This work is a starting point for the study of real scalar field systems in 3D.

12:09PM R10.00008 Physical characteristics of numerical apparent horizons. IVAN BOOTH, Memorial University of Newfoundland, STEPHEN FAIRHURST, Cardiff University — We present analytical results which enable the physical characterization of numerical apparent horizons. In particular, we introduce quantities which invariantly characterize the rate at which an apparent horizon to be either stationary or rotationally symmetric but does reduce to the standard notion for Kerr.

Monday, April 14, 2008 10:45AM - 12:09PM

Session R11 DPF: Detectors I

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis B

10:45AM R11.00001 The CMS High-Level Trigger and Trigger Menus. ARAM AVETISYAN, Brown University, CMS COLLABORATION — The CMS experiment is one of the two general-purpose experiments due to start operation soon at the Large Hadron Collider (LHC). The LHC will collide protons at a centre of mass energy of 14 TeV, with a bunch-crossing rate of 40 MHz. The online event selection for the CMS collaboration is carried out in two distinct stages. At Level-1 the trigger electronics reduces the 40 MHz collision rate to provide up to 100 kHz of interesting events, based on objects found using its calorimeter and muon subsystems. The High Level Trigger (HLT) that runs in the Filter Farm of the CMS experiment is a set of sophisticated software tools that run in a real-time environment to make a further selection and archive few hundred Hz of interesting events. The coherent tuning of the HLT algorithms to accommodate multiple physics channels is a key issue for CMS, one that literally defines the reach of the experiment’s physics program. In this presentation we will discuss the strategies and trigger configuration developed for startups physics program of the CMS experiment, up to a luminosity of 10^{31} s^{-1} cm^{-2}. Emphasis will be given to the full trigger menus, including physics and calibration triggers.
10:57AM R11.00002 Glass Beads in Liquid Scintillator. LEE PATRICK, Northwestern University — Glass beads are added to liquid scintillator in several configurations and containers. Light output from each configuration is measured as cosmic ray muons pass through the beads and scintillator. This talk will outline an effort to both understand and find a configuration that can serve as a transparent, cost-effective, high density target in future high energy experiments (e.g., a quasi-homogenous active target in neutrino experiments).

11:09AM R11.00003 Development of Digital Hadron Calorimeter Using Gas Electron Multiplier Technology. JACOB SMITH, H. BROWN, UT Arlington, C. HAN, ChangWon National University, K.P. HONG, Korean Atomic Energy Research Institute, S.N. KIM, Korea National University of Education, W.J. KIM, ChangWon National University, J. LI, C. MEDINA, UT Arlington, S. PARK, ChangWon National University, ANDREW WHITE, JAEHOON YU, UT Arlington, CALICE COLLABORATION — A sampling digital hadron calorimeter (DHCal) in combination with the Particle Flow Algorithms could provide the precise jet energy resolution demanded by the physics goals of the International Linear Collider. UTA’s High Energy Physics group has been developing a DHCal using Gas Electron Multiplier (GEM) technology. The prototype GEM detector consists of two layers of GEM foils, the thin copper-clad high voltage resistant polymer foil perforated by a high density of holes. With a high voltage applied and immersed in an easily ionizing gas, this system amplifies charge deposits from traversing charged particles in a hadronic shower. Since the readout pad can be made as small as the pitch (140 microns), GEM can resolve individual particles in the shower down to the tens of microns. Results from beam tests of GEM-based prototypes at Fermilab’s Meson Test Beam Facility and cosmic ray tests will be presented. A description of possible electronic readout systems and data acquisition options for GEM based ILC will also be presented.

11:21AM R11.00004 CMS ECAL Laser Monitoring System. YOUSI MA, Caltech, CMS COLLABORATION — The CMS Electromagnetic CALorimeter (ECAL) is a precision detector made using scintillating PbWO₄ crystals, capable of 0.5% energy resolution. However, the crystals will undergo significant changes in transparency during LHC running, and thus a monitoring system is needed to track crystal response to maintain the excellent design resolution. We will discuss the design and performance of the laser monitoring system, including new results test beams with the endcap ECAL detectors.

11:33AM R11.00005 Performance of the Transition Radiation Tracker in ATLAS using cosmic ray runs. TAEKSO SHIN, KENNETH MCFARLANE, VASSILIOS VASSILAKOPOULOS, Hampton University, O. KEITH BAKER, Yale University, ATLAS COLLABORATION — The experimental physics program at the LHC is expected to begin this year at CERN. In preparation for this research, the detectors are being commissioned in a series of cosmic ray data runs. An overview of the ATLAS detector, the data collection and analysis, and studies in preparation for first physics will be given. In this talk, emphasis will be given to the performance of the Transition Radiation Tracker in the Inner Detector.

11:45AM R11.00006 The Transition Radiation Detector of AMS 02. FENG ZHOU, MIT, AMS COLLABORATION — The Alpha Magnetic Spectrometer AMS02 is equipped with a large transition radiation detector (TRD) ready for particle identification. The positron/proton separation is essential for searching for the indirect Dark Matter signals in cosmic rays. Discrimination at 10^2 to 10^3 level between positron and proton with energy up to 300 GeV has been achieved. Readiness and maintenance free operation for more than three years in space, testing and current cosmic ray measurements will be discussed.

11:57AM R11.00007 Quantum 1/f Noise in Precision Measurements. PETER H. HANDEL, Univ. of Missouri St. Louis, Physics & Astronomy + Center for Nanoscience — An investigation of electronic 1/f noise in ultrasmall devices and systems is presented, focused on nanoscale engineering of electronic devices for low phase noise. The investigation is based on the quantum 1/f formulas and raises new questions of electronic noise, since fluctuations are more important in smaller devices. Based on the quantum 1/f noise theory, we find that in a certain transition range of sizes this general law is suspended, but reappears for 1/f noise in the nanometer domain, where the transition from coherent to conventional quantum 1/f effect is complete. The coherent and conventional quantum 1/f effects and their connection are briefly derived. The resulting quantum 1/f formulas are used to derive the 1/f noise of GaN/AIGaN MODFETs, RTDs, BAW and SAW quartz resonators, MEMS resonators, and spin valves. They are also used to calculate phase noise in these devices and in oscillators based on them, from first principles along with some classical noise sources. Device optimization is thus facilitated for ultra-small devices.

3Supported by the Army Research Office

Monday, April 14, 2008 10:45AM - 12:21PM — Session R12 DPF: Electroweak I

10:45AM R12.00001 ABSTRACT WITHDRAWN

10:57AM R12.00002 Search for ZZ production in p\bar{p} collisions using the D0 Detector. EMANUEL STRAUSS, SUNY, Stonybrook, D0 COLLABORATION — Results are presented from a search for ZZ production at the Fermilab Tevatron collider, with emphasis on the mode p\bar{p} \rightarrow ZZ \rightarrow \nu\bar{\nu}l\bar{l} with l a charged lepton. The data sample consists of approximately 2 fb^{-1} of data collected by the D0 experiment during Tevatron Run II.

11:09AM R12.00003 Measurement of Di-boson Production in Electron Plus Jets Decays. JOSEPH HALEY, Princeton University, D0 COLLABORATION — We present a measurement of the simultaneous production of a W boson in association with a second electroweak boson (W of Z) in proton-anti-proton collisions at \sqrt{s} = 1.96 TeV. We consider events with one electron, missing transverse energy, and at least two jets. Data used in this analysis consists of 1 fb^{-1} of integrated luminosity collected by the D0 detector at the Tevatron.

11:21AM R12.00004 Study of Di-boson Physics with the ATLAS Detector at LHC. HAI-JUN YANG, University of Michigan, Ann Arbor, ATLAS COLLABORATION — The talk will present studies of Standard Model diboson productions (WW,ZZ,WWZ,ZZZ) based on the ATLAS detector at LHC with proton-proton collisions at center-of-mass energy of 14 TeV. Through their leptonic decay channels with electron, muon and photon final states, we estimate SM diboson detection sensitivities in early LHC physics run using full ATLAS detector simulation Monte Carlo data samples. Advanced pattern recognition algorithm — Boosted Decision Trees is applied to improve the diboson signal selection efficiency significantly. The sensitivities of anomalous triple-gauge-boson couplings are also estimated using selected diboson signal.
11:33AM R12.00005 Physics with Dimuon Events at the Large Hadron Collider with the CMS Detector, CHANG LIU, ADAM EVERETT, NORBERT NEUMEISTER, Purdue University, CMS COLLABORATION — The Large Hadron Collider (LHC), which is scheduled to begin operation in summer 2008, will collide proton beams at a center of mass energy of 14 TeV. The Compact Muon Solenoid (CMS) detector is one of the two general-purpose experiments at the LHC, which will probe the TeV frontier of energies to search for new phenomena. One of the most promising early discoveries can be achieved by checking the dimuon signature. Dimuon events can be explored by CMS with high precision up to very high invariant masses. We present a strategy to measure the inclusive dimuon cross section with the first available data, and discuss possible discovery scenarios of high-mass dimuon resonances by searching for deviations in the invariant mass differential cross section spectrum and the forward-backward asymmetry. These measurements require the development of dedicated methods to determine trigger, reconstruction, and selection efficiencies from data, which are discussed in detail.

11:45AM R12.00006 Algebraic Approach to Massive Loop Diagrams, PAULO ROTTMANN, LAURA REINA, Florida State University — The impending high statistics measurements to be done at the LHC demand precise theoretical predictions involving higher order massive loop calculations, for example in studying the production of heavy quark pairs and heavy quark pairs with extra jets or gauge bosons or Higgs bosons. We investigate the possibility of using algebraic techniques to calculate the loop integrals appearing in 1-loop and 2-loop QCD calculations with massive particles. We test the method proposed on 1-loop integrals and study how to extend it to the case of 2-loop integrals.

11:57AM R12.00007 Measurement of the forward-backward charge asymmetry in Z/γ* → ee events with the DØ detector at the Tevatron, HANG YIN, USTC Hefei, China, D0 COLLABORATION — We present a measurement of the forward-backward charge asymmetry for dielectrons produced via an intermediate Z/γ* boson with mass between 50 and 600 GeV, using about 1 fb⁻¹ of data collected by the DØ detector in pp collisions at √s = 1.96 TeV.

12:09PM R12.00008 Toward a 0.5 ppm measurement of G_F, DAVID WEBBER, University of Illinois at Urbana-Champaign, MULAN COLLABORATION — The weak coupling constant, G_F, is determined most precisely from the muon decay, τ → μ. Advances in theory have reduced the theoretical uncertainty on G_F as calculated from τ to a few tenths of a ppm. The remaining uncertainty on G_F is entirely experimental, and is dominated by the uncertainty on τ. The MuLaN experiment is designed to measure the muon lifetime to a precision of 1 ppm, a twenty-fold improvement over the previous generation of experiments. We report an intermediate result, τ = 2.197013(24) μs (11 ppm), which is in excellent agreement with the previous world average. The mean life was measured using a pulsed surface muon beam stopped in a ferromagnetic target, surrounded by a symmetric scintillator detector array. The new world average τ = 2.197019(21) μs determines the Fermi constant G_F = 1.166371(6) × 10⁻⁵ GeV⁻² (5 ppm). Since the intermediate measurement, the detector was instrumented with waveform digitizers, the muon beam rate and beam extinction were increased. A method for tuning the underlying production spectra of secondary hadrons to match the MINOS near detector data will be presented.

Monday, April 14, 2008 10:45AM - 12:21PM
Session R13 DNP: Neutrinos II
10:45AM R13.00001 ABSTRACT WITHDRAWN
10:57AM R13.00002 Status of Dimuon Analysis in the MINOS Near Detector, AZIZUR RAHAMAN, JIAJIE LING, SANJIB MISHRA, University of South Carolina, MINOS COLLABORATION — We present the status of neutrino induced dimuon events in the MINOS Near Detector (ND). The ND has 3.2M identified µ-CC events with an identified single negative muon with an average neutrino energy (Eν) of 10.5 GeV. The dimuon analysis focuses on the neutrino charm-production where the charmed hadron decays into a positive-muon. Estimates of signal (charm) efficiency and background, and sensitivity to physics parameters such as strang quark distribution and the mass parameter of the charm quark will be presented.

11:09AM R13.00003 NuMI Beam Flux Inferred from fitting ND Data, ROBERT ARMSTRONG, Indiana University, MINOS COLLABORATION — A knowledge of the production of secondary hadrons off the NuMI target is needed to accurately predict the neutrino flux in the MINOS experiment. Tuning the underlying production spectra of secondary hadrons to match the MINOS near detector data will be described. The NuMI beam has the advantage of tuning the typical beam energy by changing the target configuration. Hadron production and the NuMI beam flux are constrained by a fit to data taken in multiple beam configurations. Preliminary results will be shown.

11:21AM R13.00004 Electron Neutrino Identification in the MINOS Detectors, TINGJUN YANG, Stanford University, MINOS COLLABORATION — The MINOS experiment has the potential to further constrain or make the first measurement of the neutrino mixing angle θ13. It is very important to understand the electromagnetic and hadronic showers in the MINOS detectors. Several discriminating methods and techniques are developed to separate the νe signals from a huge amount of backgrounds. The details of these techniques are discussed.

11:33AM R13.00005 Measurement of Hadron Production for the FNAL Neutrino Program, JONATHAN PALEY, Indiana University, MIPP TEAM — Measurements of neutrino cross-section and oscillations depend heavily on neutrino flux predictions. Such predictions rely on hadron-nucleus interaction cross-section data, and yet the data are scarce. The E907 Main Injector Particle Production (MIPP) experiment at Fermilab is a full acceptance spectrometer with excellent particle identification capabilities. MIPP has collected ~ 15 × 10^6 events of p's, π's, K's and K's at various momenta (from 5 to 120 GeV) on several targets spanning the periodic table, from hydrogen to uranium including beryllium and carbon. In particular, MIPP has collected hadron production data on a spare NuMI target using 120 GeV/c protons from the Main Injector. We review the experiment, performance of the spectrometer and show preliminary results of particle production ratios of π⁻/π⁺, K⁺/π⁺, K⁻/π⁻, and K⁻/K⁺ in bins of longitudinal and transverse momentum for thin and thick carbon targets.

11:45AM R13.00006 Characterizing Backgrounds in the NuMI Muon Monitors, JESSE CHVOJKA, University of Rochester, MINERVA COLLABORATION — The NuMI beam is a high intensity muon neutrino beam used for neutrino oscillation and neutrino cross section experiments, both of which require a well-known flux. The accompanying muon from pions and kaons decaying to a muon and muon neutrino can be used to estimate the muon neutrino flux. Muons are measured with three helium ion chambers ("muon monitors") in alcoves upstream of the MINOS near detector. Delta rays scattered off from rock and neutrons originating in the beam hadron absorber are a significant background within the monitors. We use GEANT4 to simulate the muon monitors and the effect of delta rays on measurements taken with the monitors. We also simulate the effect of inserting absorbers in front of the monitors to compare to future tests which would allow us to validate this Monte Carlo.
11:57AM R13.00007 NuSOnG: A new high-precision neutrino scattering experiment at the TeVatron. GEORGIA KARAGIROLI, Columbia University — A new high-energy, ultra-high statistics neutrino experiment, NuSOnG (Neutrino Scattering On Glass), has been proposed to study neutrino scattering at high energies with extremely high precision. I present the conceptual design of the experiment, and discuss some of its unique discovery potential for direct searches for new physics at the Terascale. These searches include searches for new light neutrino properties, new interactions manifested through rare events, and new particles such as light neutrinos, light vector bosons, etc., which appear in models for Beyond the Standard Model physics. A particular example which highlights the discovery potential of NuSOnG, is the search for evidence of “matrix freedom” or non-unitarity in the neutrino sector. Non-unitarity can manifest itself in a number of ways, such as through flavor-dependent neutrino couplings, or instantaneous flavor transitions, both of which would cause observable effects at NuSOnG.

1 For the NuSOnG Collaboration

12:09PM R13.00008 On the electroweak physics reach of the NuSOnG experiment. JAMES JENKINS, Northwestern University, NUSONG COLLABORATION — I present on the electroweak physics potential of the proposed NuSOnG (Neutrino Scattering On Glass) experiment at Fermilab. NuSOnG’s design and projected interaction rates suggest a unique physics program that can indirectly probe energy scales in excess of 5 TeV, comparable to that of the LHC! However, due to their weak current nature, neutrino scattering yields information complementary to conventional colliders in physics content. After introducing the general motivation for neutrino scattering at NuSOnG I move on to describe precision, multi-channel, measurements of Standard Model parameters. Next, I survey both direct and indirect searches for new physics via nonstandard neutrino couplings and potential Z’ interactions. This is supplemented throughout by a discussion of example models that may be constrained by this experiment.

Monday, April 14, 2008 10:45AM - 12:33PM – Session R14 DNP: Nuclear Reactions Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis G

10:45AM R14.00001 Differences in the Transverse Flow of 3H and 3He Fragments. Z. KOHLEY, E. BELL, D.V. SHETTY, G.A. SOULIOTIS, S. SOISSON, B. STEIN, S. WUENSCHEL, L. MAY, S.J. YENNELLO, Texas A & M Cyclotron Institute, NIMROD COLLABORATION — The transverse flow of 3H and 3He fragments has been examined in the reactions of 58Fe+58Fe and 58Ni+58Ni at 45 MeV/u. The calculated flow parameters showed an increase in the flow for the 3He particles in comparison to the 3H for both systems. This difference in the transverse flow demonstrates a dependence of the flow parameter on the N/Z of the particle of interest. The results from 58Fe+58Fe system are in qualitative agreement with previous theoretical predictions [1] in which the difference in the flow parameter between the 3H and 3He particles was shown to be sensitive to the density dependence of the symmetry energy. It may be possible to extract additional information from the differences in the 3H and 3He flow parameters through a comparison of the 58Fe+58Fe and 58Ni+58Ni systems.


10:57AM R14.00002 Search for the fade out of a collective enhancement of the nuclear level density. L.G. SOBOTKA, S. KOMAROV, R.J. CHARITY, C.J. CHAIRA, W. REVIOL, D.G. SARANTITSES, Washington University, A.L. CARALEY, State University of New York, Oswego, M.P. CARPENTER, D. SEWERYNIK, Argonne National Laboratory — The fade out of a collective enhancement of the nuclear level density is predicted by an SU(3) shell model. To give rise to a clear signature in the evolution of the spectral shape of evaporated charged particles with excitation energy, we have searched for this signature in the spectra of 18O nuclei with excitation energies between 54 and 124 MeV, formed in 18O + 160Gd fusion reactions. Gammaphase provided the ability to construct channel-specific α-particle spectra and thus allow for a comparison to statistical model calculations on this basis. The expected clear signature of a rapid fade out of a collective enhancement is not found. The data are best reproduced by calculations which do not explicitly consider a collective enhancement and its fade out.

11:09AM R14.00003 Detection of Neutrons and Charged-Particles emitted in Peripheral and Mid-Peripheral Collisions of 124,136Xe and 112,124Sn Nuclei at E/A = 50 MeV. A.B. MCINTOSH, J. BLACK, S. HUDAN, C.J. METELKO, R. YANEZ, R.T. DE SOUZA, Indiana Univ., A. CHIBHI, GANIL, M. FAMIANO, W. Michigan Univ., M.O. FREGEAU, J. GAUTHIER, J. MOISAN, R. ROY, Univ. Laval, S. BIANCHIN, C. SCHWARZ, W. TRAUTMANN, GSI — To investigate peripheral and mid-peripheral heavy ion collisions, neutrons and charged particles emitted in the cross-bombardment reactions 124,136Xe + 112,124Sn @ E/A = 50 MeV were measured. Projectile-like fragments at small angles (2.8° ≤ θ ≤ 14.5°) were identified by their atomic number and large velocity (V/Vbeam ≥0.5) in the Si-Si-Csl(Tl)/PD array FIRST with high angular resolution (Δθ = 0.1°). Intermediate mass fragments (IMF: Z ≥3) detected in FIRST were isotopically identified. At larger angles (30° ≤ θ ≤ 45°), light-charged particles and IMFs were isotopically identified in the silicon-strip array LASSA. With the DEMON array, pulse-shape discrimination and TOF were used to identify neutrons and measure their kinetic energies. Calibration of the charged particle detectors using fragmentation beams and electronic pulsers will be described. Elemental and isotopic resolution obtained with FIRST and LASSA will be shown; preliminary results will be presented.

1 U.S. Department of Energy, Grant No. DE-FG02-88ER40404.

11:33AM R14.00005 The influence of transport variables on isospin transport ratios. DANIEL COUL-LAND, WILLIAM LYNCH, PAWEL DANIELIEWICZ, BETTY TSANG, NSCL and Dept. of Physics and Astronomy, MSU, East Lansing, MI, YINGXUN ZHANG, China Institute of Atomic Energy, Beijing, China — The influence of transport quantities on isospin equilibration in peripheral 112Sn+112Sn, 112Sn+124Sn, 124Sn+112Sn, and 124Sn+124Sn collisions is studied in the Boltzmann-Uehling-Uhlenbeck model. The isospin transport ratio constructed from the asymmetry of the projectile residue has been shown to contain information about the density dependence of the symmetry energy. However, the ratio also depends on the momentum dependence of the mean field, in-medium isospin nucleon-nucleon cross-sections, and the stiffness of the symmetry part of the equation of state (EOS). Our simulations will try to untangle the various effects and their influence on the extraction of the symmetry energy terms in the EOS. First results from the simulations and comparisons to other transport model calculations will be presented. This work is supported by the National Science Foundation under Grant PHY-0606007.

11:45AM R14.00006 Isospin effects in two-particle correlation functions. VLADIMIR HENZL, NSCL MSU, D. HENZLOVA, M. FAMIANO, M. KILBURN, W. LYNCH, D. COUL-LAND, J. ELSON, C. HERLITZIUSS, S. HUDAN, J. LEE, S. LUKYANOVA, A. ROGERS, A. SANETULLAEV, R. DE SOUZA, L. SOBOTKA, Z. SUN, B. TSANG, A. VANDER MOLEN, G. VERDE, M. WALLACE, M. YOUNGS, *4PI+HIRA COLLABORATION — Dynamical and thermal properties of excited nuclear system produced during heavy ion collisions at intermediate incident energy can be parameterized through extensive and different correlation functions which when applied to both charged particles and light fragments provide information about space-time properties of nuclear reactions. The shape of 2-particle correlation functions reflects the nature of the final state interaction and possible presence of a collective motion driven by the nuclear EoS. BUU simulations predict that the symmetry term of the EoS will affect the 2-proton correlation function, reflecting a more pronounced pre-equilibrium emission and shorter emission times when stiffer density dependence of the symmetry term is assumed. We will present preliminary results on the isospin effect on the 2-proton correlations measured in reactions 116O+116O at 80A MeV. The experiment was performed at the NSCL/MSU using High Resolution Array (HIRA) in coincidence with the 4pi array. This work is supported by the National Science Foundation under Grant Nos. PHY-0606007 and PHY-9977707.

11:57AM R14.00007 The influence of cluster emission and the symmetry energy on neutron - proton double ratios. WILLIAM LYNCH, JINA, NSCL, and Dept. of Physics and Astronomy, MSU, East Lansing, MI 48824, USA, YINGXUN ZHANG, JINA; NSCL; China Institute of Atomic Energy, Beijing, China, PAWEL DANIELIEWICZ, JINA, NSCL, and Dept. of Physics and Astronomy, MSU, East Lansing, MI 48824, USA, MICHAEL FAMIANO, Physics Dept, WMU, Kalamazoo, MI, USA, ZHUO JI, China Institute of Atomic Energy, Beijing, China, BETTY TSANG, JINA, NSCL, and Dept. of Physics and Astronomy, MSU, East Lansing, MI 48824, USA — The emissions of neutrons, protons and bound clusters from central 124Sn+124Sn and 112Sn+124Sn collisions are simulated using the Improved Quantum Molecular Dynamics model for two different symmetry energy functions with different density dependencies. The calculated neutron - proton spectral double ratios for these two systems are sensitive to the density dependence of the symmetry energy. The effect of cluster emission and comparisons to other transport calculations such as IBUU04 will be presented. This work is supported by the National Science Foundation under Grants PHY-0555893, PHY-0606007 and PHY 0216783.

12:09PM R14.00008 Correlations between protons produced in the decay of 10C and 6Be states. R. SHANE, K.M. MERCURIO, R.J. CHARITY, J.M. ELSON, L.G. SOBOTKA, Departments of Chemistry and Physics, Washington University in St. Louis, M. FAMIANO, A. WUOSMAA, Department of Physics, Western Michigan University, A. BANU, C. FU, L. TRACHE, R.E. TRIBBLE, A.M. MUKHAMEDZHANOV, Cyclotron Laboratory, Texas A&M University — This talk will present the 2-proton correlation data from recent secondary beam experiments using the MARS separator at TAMU. The experiment itself and the extracted decay paths for 10C previously known levels and a newly discovered level are described in a separate talk by K. Mercurio. The 2-proton relative-energy and relative-angle spectra for the 10C state at E* = 6.6 MeV contain correlations that can be reproduced by R-matrix or Faddeev calculations but not sequential or three-body calculations. In the same experiment, we also collected kinematically complete data on 6Be ground-state decay. These data, as well as calculations from Grigorenko, will be presented in Jacobi “T” and “Y” coordinates.

12:21PM R14.00009 Isoscaling studies of reconstructed quasi-projectiles in 24Mg, 40Ca+112,124Sn reactions at 32 MeV/μ. STRATOS GALANOPOLOUS, Cyclotron Institute, Texas A&M University, College Station, Texas 77843, G.A. SOULIOTIS, A.L. KEKIS, M. VESELSKY, M. JANDEL, D.V. SHETTY, Z. KOHLEY, S. SOISSON, B. STEIN, S. WUENSCHEL, S.J. YENNELLO — The isotopic distribution of the reaction products are sensitive observables in the study of the charge asymmetry term in the nuclear Equation of State, (nEOS) [1]. Studies on heavy-ion reactions near Fermi-energy region showed that the yield ratio of a given fragment coming from a neutron-rich vs a neutron deficient fragmenting system follows an exponential dependence with respect to the neutron and proton number of the fragments, an effect termed isoscaling (e.g. [2]). In this work, we study the isoscaling in 24Mg, 40Ca+112,124Sn reacting systems from reconstructed quasi-projectile events (QP’s), for the determination of the isoscaling parameter α. The measurements were performed at the K500 Cyclotron accelerator of Texas A&M University using 24Mg and 40Ca beams at 32 MeV/μ. The projectile fragments were detected by the Forward Array Using Silicon Technology (FAUST) [3]. Properties of the reconstructed QP’s were also systematically investigated (e.g. velocity and E/A distributions). References [1] M. Colonna et al., Eur. Phys. J. A 30, 165, (2006). [2] G. A. Souliotis et al., Phys. Rev. C 73, 024606 (2006). [3] F. Gimen-Nogues et al., Nucl. Instr. Meth. A 399, 94 (1997).

Monday, April 14, 2008 10:45AM - 12:33PM — Session R15 DNP: Electromagnetic Interactions | Hyatt Regency St. Louis Riverfront (formerly Adam039s)s Mark Hotel, St. Louis H

10:45AM R15.00001 Two Photon Exchange (TPE) Experiment at CLAS. MEGH NIROULIA, Old Dominion University, CLAS COLLABORATION TEAM — The ratio of the Electric (G_E) and magnetic (G_M) form factors of the proton measured by Rosenbluth Separation and Polarization Transfer methods differ by a factor of three at Q^2 of 5.6 GeV^2. The real part of the Two Photon Exchange (TPE) amplitude in lepton-proton elastic scattering is expected to explain this discrepancy. The ratio of elastic positron-proton to electron-proton cross sections is the only way to measure this real part. We will measure this cross section ratio using a mixed electron-positron beam in CLAS at Jefferson Lab. In this talk I will present how the electron-positron beam is produced, the backgrounds that limit our luminosity and the simulations used to reduce those backgrounds.

10:57AM R15.00002 Photodisintegration of Deuterium at Low Energies: Measurements of Cross Section and Fore-Aft Asymmetries Between Eγ of 2.44 and 4 MeV at the High Intensity γ-Ray Source (HIγS). M.W. AHMED, Duke University and TUNL, S.S. HENSHAW, B.A. PERDUE, S. STAVE, H.R. WELLER, Duke University and TUNL, L. LI, S. MIKHALOV, Y. WU, Duke U. and DFELL — Data were taken recently at HIγS to obtain cross section and fore-aft asymmetry measurements in photodisintegration of the deuteron in the energy region of astrophysical importance. Linearly polarized γ-rays (ΔE/E, ΔE/Eγ > 3%) were incident on a thin D₂O target and the outgoing neutrons were detected using three Li-glass detectors placed in the plane of polarization at center-of-mass scattering angles (θ) of 54°, 88°, and 125°. A preliminary analysis indicates small, but non-zero, asymmetries. An outline of the analysis to extract asymmetry and cross sections within an error of ~ 10 % will be presented. The acquisition and analysis of data used to extract the efficiency of the Li-glass detectors will also be presented. The significance of the asymmetry and cross section measurements will be discussed.
11:09AM R15.00003 Measurement of Two Photon Exchange in the ep Elastic Scattering Process using Recoil Polarization, WEI LUO, Landau Institute for Theoretical Physics, RUSSIA; THE JEFFERSON LAB HALL C GEP-III COLLABORATION — The explanation of the discrepancy between electric form factor measured with recoil polarization and Rosenbluth separation data has been focused on contribution of two photon exchange process which was ignored in the previous radioactive corrections. Experiment E04-109 running at Jefferson Lab Hall C searched for out-of-plane polarization component due to two gamma exchange in the ep elastic scattering process using recoil polarization method. This effect requires small systematical uncertainty to be seen. Two detectors played essential role in this measurement, BigCal and FPP. BigCal is the electromagnetic calorimeter which detects electrons to make coincidence with HMS which is the standard Jefferson Lab Hall C spectrometer to measure protons. The BigCal is used to reject inelastic contribution to get clear elastic scattering events, and FPP is the detector to measure the polarization of protons in HMS focal plane. The preliminary results of BigCal performance and the helicity independence asymmetries measured at 3 kinematics points at $Q^2 = 2.5$ GeV$^2$ will be reported.

1Supported in part by the DOE and the NSF

11:21AM R15.00004 $\pi^-/\pi^+$ Ratios of Separated Response Functions in Forward Pion Electroproduction, CORNEL BUTUCEANU, University of Regina, SK, CANADA; MEHDI MEZIANE, The College of William and Mary, JEFFERSON LABORATORY GEP-III COLLABORATION — The first complete separation of the four unpolarized electromagnetic response functions above the dominant resonances has been made for forward, exclusive $\pi^\pm$ electroproduction on the nucleon in the $Q^2 = 0.6 - 2.45$ (GeV/c)$^2$ range. The separated ratio $R_L = \sigma_L^\pi^-/\sigma_L^\pi^+$ is sensitive to isoscalar contamination to the dominant isovector pion exchange amplitude, which is the basis for the determination of the charged pion form factor, $F_\pi(Q^2)$ from electroproduction data. The value of this ratio may also have implications for constraining polarized GPD’s with ratios of longitudinal observables. At large $-t$, a separate ratio $R_T = \sigma_T^\pi^-/\sigma_T^\pi^+ \simeq 1/4$ would suggest a transition between pion and quark knockout mechanisms. Preliminary results on the separate ratios $R_L$ and $R_T$ indicate a dominance of the pion pole diagram at low $-t$. The results will be compared with a variety of models such as the VGL model.

11:33AM R15.00005 Hard Photo-disintegration of proton pairs in $^3$He, RONALD GILMAN, Rutgers University, ELI PIASETZKY, ISHAY POMERANTZ, Tel Aviv University, JEFFERSON LAB HALL A COLLABORATION — Hard deuteron photo-disintegration has been investigated for 20 years, as its cross sections follow the constituent counting rules and it provides insight into the interplay between hadronic and quark-gluon degrees of freedom in high-momentum transfer exclusive reactions. We have now measured for the first time hard pp-pair disintegration in the reaction $^3$He $\rightarrow pp + n$, using kinematics corresponding to a spectator neutron. The current state of the analysis will be shown. Clues to the underlying physics can be found in our measurements with deuteron photo-disintegration, the energy dependence of the cross sections at 90$^\circ$ c.m., and the $\alpha_{\pi n}$ distribution.

11:45AM R15.00006 A new focal plane polarimeter to measure the proton form factor ratio, MEHDI MEZIANE, The College of William and Mary, JEFFERSON LABORATORY GEP-III COLLABORATION — One of the two methods available to measure the elastic form factors of the proton, is a measurement of the polarization of the recoil proton in $\vec{e}p$; the other is the standard Rosenbluth separation based on cross section. A new experiment in Hall C at JLab is measuring the ratio $G_{Ep}/G_{Mp}$ by the recoil polarization method. The polarization of the recoil proton is measured by a new polarimeter (FPP) built and installed near the focal plane of the high momentum spectrometer in Hall C. In this FPP, the protons are scattered in an analyzer and the azimuthal angular distribution of the proton is measured. To maximize the number of interactions in the FPP, two analysers in series are used, each followed by a pair of drift chambers. Performances, resolution and efficiency will be discussed. A preliminary result of the new ratio $G_{Ep}/G_{Mp}$ at $Q^2 = 5.2$ GeV$^2$ will be shown.

1Supported by partially by NSF and DOE; sponsored by C.F Perdrisat

11:57AM R15.00007 New Measurements of the Proton Spin-Structure Functions $g_1$ and $g_2$ in and above the Resonance Region, ROBERT FERSCH, College of William and Mary, CLAS COLLABORATION — The CLAS (CEBAF Large Acceptance Spectrometer) EG1b experiment in Hall-B at Jefferson Laboratory measured double-spin inclusive and exclusive electron-nucleon scattering asymmetries using longitudinally polarized frozen NH$_3$ and ND$_3$ targets and a longitudinally polarized electron beam at 4 different energies (1.6, 2.5, 4.2, 5.6 GeV). Extraction of the virtual photon asymmetry $A_1$ (for 0.05 GeV$^2 < Q^2 < 4.0$ GeV$^2$) provides precision measurements of the polarized spin-structure function $g_1$ in and above the resonance region. Linear regression of data between the varying energies yields new constraints on the virtual photon asymmetry $A_2$ (and thus the structure function $g_2$) in the resonance region (for 0.3 GeV$^2 < Q^2 < 1.0$ GeV$^2$). Measurements of these structure functions and their moments allows testing of QCD models, sum rules, foward-spin polarizability and duality for the proton.

1Supported by partially by NSF

12:09PM R15.00008 Photoproduction of the Sigma(1385) resonance at LEPS, KENNETH HICKS, Ohio University, LEPS COLLABORATION — The Sigma(1385) hyperon resonance has been measured using the LEPS detector at the SPring-8 facility in Japan. Linearly polarized photons in the range of 1.5-2.4 GeV were incident on a liquid deuterium target, producing a $K^+$ and a $\pi^-$ in the final state. The negative Sigma(1385) was isolated by its decay to ($\Lambda\pi^-$) using the missing mass technique. The same final state particles can also be used to identify photoproduction of the $\Sigma^-$ ground state via its decay to ($\Lambda\pi^-\pi^-$). Using simulations to correct for the detector acceptance, it will be possible to link the cross sections for the Sigma(1385) to the previously measured cross sections for photoproduction of $K^+\Sigma^+$ from the neutron in progress, and will be discussed along with the data analysis of this reaction.

1Supported in part by the NSF
Next generation \(\Lambda\)-hyypernuclear spectroscopy via the \((e,e'K^+)\) reaction at Jefferson Lab\(^1\), TOMOFUMI MARUTA, Tohoku University, JEFFERSON LAB E05-115 COLLABORATION — Spectroscopic studies via the \((e,e'K^+)\) reaction are a very important complementary technique to investigate \(\Lambda\)-hyypernuclear structure; the reaction favorably excites spin-flip states and on light nuclei, compared to the meson-induced reactions, produces mirror hyypernuclei. So far, it is the only technique that allows absolute mass determination with accuracies of \(\approx 100\) keV or better. Two previous experiments that we performed, E89-009 & E01-011, established the experimental technique, and the latter obtained hypernuclear mass spectra up to \(\Lambda \approx 30\) with, for reaction spectroscopy, unprecedented energy resolution down to 400 keV (FWHM). Our next experiments will investigate \(\Lambda\) hyypernuclei up to \(^5\)Sr. A newly constructed electron spectrometer (HES) and splitter magnet will increase the yield by almost one order of magnitude while preserving the achieved energy resolution. Together with the existing Koon Spectrometer (KHS), they are scheduled for installation in Jefferson Lab’s Hall C in 2009. The planned experimental program will for the first time in \((e,e'K^+)\) reaction spectroscopy also explore \(\Lambda\)-hyypernuclei beyond the p-shell. This presentation will give a status report and outline the experimental program and technique of the E05-115 experiment.

\(^1\)Supported by DoE ER41047 & ER41065 and MEXT, Japan.

11:45AM R16.00001 Effectiveness of different tutorial recitation teaching methods and its implications for TA training\(^1\), ROBERT ENDORF, University of Cincinnati — We present results from a comparative study of student understanding for students who attended recitation classes that used different teaching methods. The purpose of the study was to evaluate which teaching methods would be the most effective for recitation classes associated with large lectures in introductory physics courses. Student volunteers from our introductory calculus-based physics course at the University of Cincinnati attended a special recitation class that was taught using one of four different teaching methods. A total of 272 students were divided into approximately equal groups for each method. Students in each class were taught the same topic, “Changes in Energy and Momentum,” from “Tutorials in Introductory Physics” by Lillian McDermott, Peter Shaffer and the Physics Education Group at the University of Washington. The different teaching methods varied in the amount of student and teacher engagement. Student understanding was evaluated through pretests and posttests. Our results demonstrate the importance of the instructor’s role in teaching recitation classes. The most effective teaching method was for students working in cooperative learning groups with the instructors questioning the groups using Socratic dialogue. In addition, we investigated student preferences of modes of instruction through an open-ended survey. Our results provide guidance and evidence for the teaching methods which should be emphasized in training course instructors.

\(^1\)Supported in part by NSF grant DUE-0126919

12:18PM R15.00009 Next generation \(\Lambda\)-hyypernuclear spectroscopy via the \((e,e'K^+)\) reaction at Jefferson Lab\(^1\), TOMOFUMI MARUTA, Tohoku University, JEFFERSON LAB E05-115 COLLABORATION — Spectroscopic studies via the \((e,e'K^+)\) reaction are a very important complementary technique to investigate \(\Lambda\)-hyypernuclear structure; the reaction favorably excites spin-flip states and on light nuclei, compared to the meson-induced reactions, produces mirror hyypernuclei. So far, it is the only technique that allows absolute mass determination with accuracies of \(\approx 100\) keV or better. Two previous experiments that we performed, E89-009 & E01-011, established the experimental technique, and the latter obtained hypernuclear mass spectra up to \(\Lambda \approx 30\) with, for reaction spectroscopy, unprecedented energy resolution down to 400 keV (FWHM). Our next experiments will investigate \(\Lambda\) hyypernuclei up to \(^5\)Sr. A newly constructed electron spectrometer (HES) and splitter magnet will increase the yield by almost one order of magnitude while preserving the achieved energy resolution. Together with the existing Koon Spectrometer (KHS), they are scheduled for installation in Jefferson Lab’s Hall C in 2009. The planned experimental program will for the first time in \((e,e'K^+)\) reaction spectroscopy also explore \(\Lambda\)-hyypernuclei beyond the p-shell. This presentation will give a status report and outline the experimental program and technique of the E05-115 experiment.

\(^1\)Supported by DoE ER41047 & ER41065 and MEXT, Japan.
12:09PM R16.00006 Addressing student difficulties with aspects of partial differentiation in upper-level thermodynamics. BRANDON BUCY, JOHN THOMPSON, DONALD MOUNTCASTLE, University of Maine — We have reported previously that students demonstrate an inability to correctly equate the mixed second-order partial derivatives of the state function of volume (nonzero quantities in general), arguing instead that these derivatives must identically equal zero. Based on the results of our research, we have developed, designed and implemented a guided-inquiry instructional sequence (“tutorial”) for upper-level undergraduate thermodynamics students to address this and related student difficulties with partial derivatives encountered on diagnostic questions. The sequence uses a graphical interpretation of partial derivatives in the context of an ideal gas $P = V^{-1} T$ surface to bridge the abstract mathematical concepts with concrete physical properties. We present pre- and post-instruction data from a classical thermodynamics course in which the tutorial was administered, and compare those outcomes to results obtained after lecture-based instruction. Based on these results, it appears that the tutorial not only addressed the difficulty discussed above but also positively impacted student performance in related topics later in the course.

1Supported in part by NSF Grants PHY-0406764 and REC-0633951.

12:21PM R16.00007 A revision of college students' concept domain of lunar phases. REBECCA LINDELL, Southern Illinois University Edwardsville — Previous research (Lindell, 2001) showed that college students' lunar phases concept domain consisted of 8 dimensions: Period of Moon's orbit, Period of Moon Phases, Direction of Moon's orbit around the Earth, Motion of the Moon in the sky, Phase and Sun-Earth-Moon relationship, Phases-Location in the Sky-Time of Observation relationship, Cause of Phases and Effect of Location on Earth on observed phase. Each dimension uncovered has a number of facets, each representing the scientific correct answer, as well as the different alternative models possible. In a follow-up study, interview data was collected from 25 pre-service elementary education majors. This additional study uncovered previously undiscovered difficulties students’ had with lunar phases. The discovery of these new difficulties resulted in the need to revise the original concept domain. The new revised concept domain will be presented as well as proposed changes to the successful Lunar Phases Concept Inventory (LPCI) to account for this change.

12:33PM R16.00008 Evolution is only a theory? MURRAY PESHKIN, Argonne National Laboratory* — I have been speaking to diverse groups about science and religion in the context of the attacks on the teaching of biological evolution in public schools. My audiences have included church groups, classrooms, business clubs, and general public. In explaining why science does not threaten most people’s religious beliefs and why belief in evolution is not really optional, I have learned that most people have never been told what a theory is and how we know when it’s right, or what it means that our theories are always provisional but well-established theories are nevertheless reliable where they apply. It seems that we have taught students and the public about gravity and DNA, but never told them what science is all about. We need to do better. The people I have addressed have mostly appreciated hearing about these things and about why science, properly understood, does not deny most people’s religious beliefs. I will discuss these and other lessons I have learned from the reactions to my talks. *For identification. This work is not supported by Argonne Natl. Lab.

Monday, April 14, 2008 10:50AM - 11:40AM – Session 13HE HEDP HEDLA: Laboratory Studies of Dense Matter II Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade F

10:50AM 13HE.00001 Pressure ionization and phase transition in strongly coupled plasmas at megabars VLADIMIR FORTOV, IHED RAS — The investigation of electrical conductivity and thermodynamic properties of strongly coupled nonideal plasmas quasiquasimentropicely compressed by reverberating shock waves up to megabars was carried out. HE-driven generators of intense shock waves were used for generation of warm and dense strongly non-ideal plasma with intense interparticle interaction and mixing Fermi-Boltzmann statistics. Flash highly resolved X-ray diagnostics were used to measure adiabatic compressibility of the plasma. The thermodynamic measurements demonstrate density increase at megabar pressure just in the density range where the electrical measurements have shown sharp – five order of magnitude – electrical conductivity increase due to pressure ionization in strongly coupled plasmas. These thermodynamic experimental data in combination with the electrical conductivity measurements were interpreted as the experimental signature of the specific phase transition in strongly non-ideal plasma. The existence of this new phase transition is supported by the ab initio Quantum Monte-Carlo, Density Functional Theory, and Molecular Dynamic simulations. Pressure dielectrization in shock compressed Li, Na, Ca was detected and discussed.

11:15AM 13HE.00002 High energy density physics experiments with intense heavy ion beams, FRANK BIENIESEK, LBNL — The US heavy ion fusion science program has developed techniques for heating ion-beam-driven warm dense matter (WDM) targets. The WDM conditions are to be achieved by combined longitudinal and transverse space-charge neutralized drift compression of the ion beam to provide a hot spot on the target with a beam spot size of about 1 mm, and pulse length about 1-2 ns. As a technique for heating volumetric samples of matter to high energy density, intense beams of heavy ions are capable of delivering precise and uniform beam energy deposition dE/dx, in a relatively large sample size, and the ability to heat any solid-phase target material. Initial experiments use a 0.3 MeV K+ beam (below the Bragg peak) from the NDCX-1 accelerator. The NDCX-II accelerator planned for the 2010 time frame is designed to heat targets at the Bragg peak using a 3-6 MeV lithium ion beam. The range of the beams in solid matter targets is about 1 micron, which can be lengthened by using porous targets at reduced density. We have developed a WDM target chamber, a cone focusing element to concentrate ion beam energy deposition on target, and a suite of target diagnostics including a fast multi-channel optical pyrometer, optical streak camera, VISAR, and high-speed gated cameras. Initial WDM experiments for 2008 will explore target parameters such as temperature and electrical conductivity.

1This work performed under the auspices of the U.S Department of Energy by University of California, Lawrence Berkeley National Laboratory under contract No. DE-AC03-76SF00098.

Monday, April 14, 2008 11:40AM - 2:25PM – Session 14HE HEDP HEDLA: HEDP Theory and Experiments Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade F
11:40AM 14HE.00001 Studies of High Energy Density Matter Using Intense Ion Beams: The HEDgeHOB Collaboration, N.A. Tahir, GSI Darmstadt — Extensive theoretical work done over the past years that included sophisticated 2D and 3D numerical simulations as well as analytic modeling, has shown that intense heavy ion beams are an excellent tool for creating large samples of High Energy Density (HED) matter with fairly uniform physical conditions [1]. It has been found that one may employ an ion beam using two very different experimental configurations that are named HIIX [2,3] and LAPLAS [4,5]. The former scheme involves isochoric and uniform heating of matter by an ion beam that is followed by isentropic expansion of the heated material. Using this technique, one can access the entire phase diagram including those regions which cannot be accessed by traditional methods of shock waves. The second scheme considers a multiple shock reflection technique that allows one to achieve a low-entropy compression of a test material like hydrogen or water which generates physical conditions that are expected to exist in the interior of giant planets. Interesting physical problems like Rayleigh-Taylor and Richtmyer-Meshkov instabilities have also been investigated in detail. This work has provided the necessary basis for the HEDgeHOB scientific proposal for experiments at the Future Facility for Antiprotons and Ion Research [FAIR], at Darmstadt. [1] N.A. Tahir et al., PRE 60 (1999) 4715. [2] D.H. Hoffmann et al., PoP 9 (2002) 3652. [3] N.A. Tahir et al., PRL 95 (2005) 035001. [4] N.A. Tahir et al., PRE 62 (2000) 016402. [5] A.R. Pirié et al., PRE 66 (2002) 056403.

12:05PM 14HE.00002 Monoenergetic Proton Radiography of Electromagnetic Fields in Laser-Plasma Interactions and Areal Density in Imploded Capsulesa,b, RICHARD PETRASSO, MIT — An isotropic, monoenergetic proton backlighter source with matched detector has been utilized on the OMEGA laser system to accurately and sensitively study the following: First, MG fields generated by laser plasma interactions [1,2] and wave breaking instabilities. Second, the reconnection of MG fields of interacting laser generated magnetic bubbles [3]. Third, the fields and areal density evolution for cone-in-shell implosions [4,5]. And fourth, the fields and areal density evolution of spherical implosions. Mottled, complex field structures are sometimes observed during the implosions. Because of the precise energy of the 14.7 (3.0) MeV P and 3.5 MeV alpha backlighter particles, a result of the fusion reaction of D and 3He (and DD) in an exploding pusher, a quantitative relationship can be established between particle energy loss and areal density (through stopping power) or between deflection field strength (via the Lorentz force). Results of these experiments, as well as those currently being planned, such as accurate stopping power measurements in warm dense matter, will be presented.

a) In collaboration with scientists from MIT, LLNL, and LLE.

b) Supported by NULF Contract DE-FG52-2005NA26011 and UR/FSC Contract 412761-G.


12:30PM 14HE.00003 LUNCH BREAK –

Monday, April 14, 2008 1:30PM - 3:18PM –
Session S2 DPF: American Particle Physics in the Coming Era II Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis D

1:30PM S2.00001 Exploring the Neutrino Questions, ANDRE DE GOUVEA, Northwestern University — Neutrinos are the most elusive of the fundamental constituents of matter and are responsible for the biggest particle physics discovery of the past decade: contrary to theoretical expectations, it is now established that neutrinos have mass. I’ll review what we have learned about neutrino properties, and describe a list of known unknowns that can only be addressed by several distinct next-generation neutrino experiments. I’ll also discuss what we have learned about the new physics unlocked by neutrino experiments, and speculate about what we can hope to learn in the near future.

2:06PM S2.00002 DUSEL and its Physics Program1, KEVIN LESKO, UC Berkeley — The recent discoveries by the SNO, KamLAND, and Super-K collaborations; the precision measurements at MINOS, Borexino, and K2K; and the significant increases in dark matter sensitivities reported by CDMS and Xenon10, have highlighted the increasing world-wide interest in underground physics, astrophysics and other fields of science that require deep underground laboratory and research facilities. The National Science Foundation has embarked on the third and fourth stages of a program to establish a world-class, multi-disciplinary deep underground science and engineering laboratory - DUSEL. The first stage of this effort to assess the scientific drivers was completed with the release of Deep Science ([http://www.deepscience.org/](http://www.deepscience.org/)) and the associated Town Meetings ([http://cosmology.berkeley.edu/DUSEL/Town_meeting_DC07](http://cosmology.berkeley.edu/DUSEL/Town_meeting_DC07)) in November 2007. I shall review this report’s finding on the scientific motivations for DUSEL, the documented shortage of underground space to pursue the experiments, and additional facility requirements that influence DUSEL’s design. The NSF’s DUSEL Review Panel in July 2007 selected the former Homestake mine in South Dakota as the prime site to be developed for an international world-class research facility. I shall review the Homestake facility plans ([http://www.lbl.gov/nsf/homestake/](http://www.lbl.gov/nsf/homestake/)) including the near-term experimental program hosted by the state-sponsored Sanford Laboratory and the plans for the development of the entire site as a multidisciplinary user facility with depths extending to 8000 feet below ground. Our plans for DUSEL as an NSF Major Research Equipment and Facilities Construction proposal would provide funding for the facility as well as significant Initial Suite of Experiments (ISE). The Initial Suite of Experiments would be constructed concurrently with the facility as early as 2011 or 2012. I shall review a number of candidate experimental programs being considered for DUSEL’s Initial Suite of Experiments of particular interest to the particle physics community including: a comprehensive long baseline neutrino program, nucleon decay experiments, dark matter searches, neutrinoless double beta decay experiments as well as solar and geoneutrino measurements and potential gravity wave and n-bar oscillation experiments.

1 Work supported by the NSF under cooperative agreement PHY-0717003.
2:42PM S2.00003 The Future US Cosmology Program, GARY BERNSTEIN, University of Pennsylvania — There is now a standard cosmological theory that is consistent with all extant data, including for the first time cosmological measurements of very high accuracy. The “concordance model,” however, contains three elements with weak theoretical motivation and no laboratory verification: a dark matter particle, a non-zero cosmological constant, and a field to drive inflation. Where do we go from here? I will describe observational opportunities that exist in several areas: (1) Testing General Relativity on large scales, where it underlies the concordance model; (2) Detecting signals that originate during cosmological epochs that are presently unobserved: gravity waves from the early Universe, and 21-cm signals from redshifts 6–50; (3) High-precision measurements of the expansion and matter-clustering history of the Universe, to gain further information on the “dark” phenomena; (4) More detailed understanding of the paradigm that galaxies form by collapse of baryons into dark-matter potential wells. I will describe US facilities proposed to exploit these observational opportunities.

Monday, April 14, 2008 1:30PM - 3:18PM –
Session S3 DNP: DNP Dissertation Awards

1:30PM S3.00001 Investigating Neutron Polarizabilities through Compton Scattering on Light Nuclei, DEEPSHIKHA SHUKLA, George Washington University — This talk will focus on elastic Compton scattering on He-3 as an instrument to extract the neutron electric and magnetic polarizabilities. The calculations for this process have been performed for photon energies comparable to the pion mass within the framework of Chiral effective field theory. The results show that these computations, when used in concert with future data from HIGS and results from recent deuterom Compton scattering, should give significant new information about the neutron polarizabilities.

2:06PM S3.00002 Using neutrinos to study the earth, NIKOLAI TOLICH, University of Washington — Mantle convection and earthquakes are generally thought to be driven by the heat produced from uranium and thorium decays inside the earth. The KamLAND experiment has recently observed neutrinos originating from these decays, pioneering a new way to probe the earth’s interior. While this measurement is consistent with earth models based on the chemical composition of meteorites and heat flow measurements on the earth’s surface, it is not precise enough to constrain those models. It is interesting to note that we still know less about the nuclear reactions within the earth, just below our feet, than within the sun, an object 92 million miles away. More precise future measurements of neutrinos from the earth will have a significant impact on our understanding of the earth by constraining mantle convection and earth formation models. I will discuss my dissertation geo neutrino measurement with KamLAND, and plans for future experiments.

2:42PM S3.00003 Precision measurement of the weak charges of quarks, ROSS YOUNG, Argonne National Laboratory — The Standard Model has been enormously successful at predicting the outcomes of experiments in nuclear and particle physics. The search for new physical phenomena and a fundamental description of nature which goes beyond the Standard Model is driven by two complementary experimental strategies. The first is to build increasingly energetic colliders, such as the Large Hadron Collider (LHC) at CERN, which aim to excite matter into a new form. The second, more subtle approach is to perform precision measurements at moderate energies, where an observed discrepancy with the Standard Model will reveal the signature of these new forms of matter. Here we use precision parity-violating electron scattering measurements on nuclear targets to extract the weak charges of the quarks. The result is found to be in excellent agreement with the predictions of the Standard Model. Combining this result with earlier measurements of the low-energy weak force, most notably data on parity violation in atomic cesium, lifts the relevant energy scale for physics beyond the Standard Model to almost 1 TeV.

Monday, April 14, 2008 1:30PM - 3:18PM –
Session S4 DAP: Numerical Relativistic Astrophysics

1:30PM S4.00001 Core-Collapse Supernova Mechanisms and their Signature in Gravitational Waves, CHRISTIAN DAVID OTT, Department of Astronomy and Steward Observatory, The University of Arizona — Despite many decades of concerted theoretical effort and numerical modeling, the details of the core-collapse supernova explosion mechanism are still under debate. Indications are strong that the supernova mechanism is intrinsically multi-dimensional and involves a combination of postbounce energy deposition by neutrinos, convective instability, the standing-accretion-shock instability (SASI), unstable protoneutron star core g-mode oscillations, rotation, magneto-hydrodynamic effects, and nuclear burning. I review the current status of core-collapse supernova theory and modeling and introduce the ensemble of viable candidate explosion mechanisms that is emerging from recent multi-dimensional core collapse and postbounce supernova models. I go on to discuss gravitational-wave emission processes in core-collapse supernovae and present new results on the supernova gravitational-wave signature that were obtained with 2D/3D general relativistic and Newtonian astrophysics models.

2:06PM S4.00002 Interplaying analytical and numerical relativity in modeling binary black hole coalescences, ALESSANDRA BUONANNO, University of Maryland — The coalescence of two black holes is one of the most energetic events in the Universe, emitting 2-8% of the initial rest-mass energy in gravitational waves. I will review how recent work at the interface between analytical and numerical relativity is improving our understanding of the binary black hole dynamics and gravitational-wave emission throughout inspiral, merger and ringdown phases. I will discuss the implications of those results in the search for gravitational-waves with ground and space based detectors, and in astrophysics, notably for the distribution of recoil velocities from merging black holes.

2:42PM S4.00003 Hydrodynamic Calculations of Compact Binary Mergers, EMMANOUELA RANTSIOU, Northwestern University — I will briefly review recent results from relativistic hydrodynamic calculations of compact binary mergers, with particular emphasis on black hole - neutron star mergers. The gravitational wave signatures from both misaligned, spinning components leads to a rich variety of merger morphologies and outcomes, with a correspondingly broad variety of gravitational wave signatures.

1 This work was supported by NASA grants NNX04HI17G and NAG5-12885.
1:42PM S8.00002 Imaging 2-20 MeV solar neutrons in the inner heliosphere with the SONNE detector1, J. RYAN, U. BRAVAR, P. BRUILLARD, University of New Hampshire, E. FLUECKIGER, University of Bern, A. MACKINNON, University of Glasgow, J. MACRI, University of New Hampshire, P. MALLIK, University of Glasgow, B. PIRARD, University of Bern, R. WOOLF, University of New Hampshire — The Solar Neutrino Experiment (SONNE), a neutron detector with imaging and energy measurement capabilities sensitive to neutrons in the 2-20 MeV energy range, is specifically conceived as a candidate instrument for the Solar Sentinels program. Different design concepts have been explored to optimize the detection capabilities for solar-flare neutrons in the inner heliosphere. The detection principle is based on multiple elastic neutron-proton scatterings inorganic scintillators. By measuring the scattering coordinates and determining the energy of recoil protons and time of flight of scattered neutrons, the energy spectrum and incident direction of primary neutrons can be reconstructed. We present the results of calibrations and further simulations that demonstrate that the instrument meets the requirements for unprecedented sensitive measurements of low-energy solar neutrons. We confirm that the instrument has an energy resolution of $\sim20\%$ over a wide range of energies and that its angular resolution is of order 15 degrees allowing for heavy background suppression. Furthermore, the efficiency agrees with the Monte Carlo model allowing us to extrapolate to the full instrument that may be deployed on Solar Sentinels.

1We acknowledge support from NA-22 of NNSA for supporting this work.

1:54PM S8.00003 The growth of magnetic turbulence and transport of cosmic rays in supernova remnant precursors. BRIAN REVILLE, Max-Planck Institut fuer Kernphysik, JOHN KIRK, Max Planck Institut fuer Kernphysik, STEPHEN O’SULLIVAN, Dublin City University, PETER DUFFY, UCD Dublin — The process of first order Fermi acceleration in supernova remnant shocks has long been of interest. However, it has only recently been modeled in the context of supernova remnants. In these models, turbulence occurs in a region where the stellar surface. Careful attention is paid to accurately calculating the yield of material burned to nuclear statistical equilibrium (NSE) and then frozen out in the expansion following the detonation wave which sweeps over the white dwarf. A self regulating process comprised of neutronization and pre-expansion leads to $\sim0.1-0.3$ $M_{\odot}$ and the explosion energies are $\sim1.5\times10^{51}$ ergs, comparable to observed luminous type Ia supernovae (Ia SNe). Multi-point ignition can lead to lower luminosity explosions by releasing more energy in the deflagration which goes into expanding the white dwarf prior to detonation. A suite of expanded surface detonation models are presented which have explosion energies and $^{56}$Ni masses spanning those of observed Ia SNe. Synthetic spectra and light curves are being generated from the multi-dimensional models for more direct comparison to observed Ia SNe.

2:06PM S8.00004 Surface Detonation Models of Type Ia Supernovae, CASEY MEAKIN, FLASH CENTER TEAM — Flame propagation and subsequent detonation in near-Chandrasekhar mass, carbon/oxygen white dwarf stars are studied using multi-dimensional, reactive hydrodynamical simulation. The single off-center bubble ignition models studied by Townsley et al. (2007) are extended through detonation and into the homogeneous expansion phase. In these models, detonation occurs in a collision region at the stellar surface. Careful attention is paid to accurately calculating the yield of material burned to nuclear statistical equilibrium (NSE) and then frozen out in the expansion following the detonation wave which sweeps over the white dwarf. A self regulating process comprised of neutronization and pre-expansion leads to $\sim1.1M_{\odot}$ of $^{56}$Ni synthesized in all of the single point ignition models studied. The yield of intermediate mass elements is $\sim0.1-0.3$ $M_{\odot}$ and the explosion energies are $\sim1.5\times10^{51}$ ergs, comparable to observed luminous type Ia supernovae (Ia SNe). Multi-point ignition can lead to lower luminosity explosions by releasing more energy in the deflagration which goes into expanding the white dwarf prior to detonation. A suite of expanded surface detonation models are presented which have explosion energies and $^{56}$Ni masses spanning those of observed Ia SNe. Synthetic spectra and light curves are being generated from the multi-dimensional models for more direct comparison to observed Ia SNe.

2:18PM S8.00005 The Roles of Nuclear Physics during Stellar Core Collapse1, WILLIAM HIX, ORNL/UTK, ERIC LENTZ, UTK/ORNL, MARK BAIRD, UTK, BRONSON MESSER, ORNL/UTK — Nuclear electron capture and the nuclear equation of state play important roles during the collapse of a massive star and the subsequent supernova. The nuclear equation of state of state contains the nature of the bounce which initially forms the supernova shock and the electron capture determines the location where this shock forms. Advanced in nuclear structure theory have allowed a more realistic treatment of electron capture in supernovae to be developed. With this improvement, we have shown that electron capture on nuclei with masses larger than 50 dominantes electron capture on free protons, producing significant changes in the hydrodynamics of core collapse and bounce. We will present explorations of the impact of weak interactions with heavy nuclei in supernovae, focusing on the consequences across the range of supernova progenitors. Examination of the sensitivity of these effects to variations in the electron capture rates will also be presented. Additionally, we will present simulations showing the impact of a variable nuclear equation of state on supernova shock propagation and the interplay between electron capture and the equation of state.

1ORNL is managed by UT-Battelle, LLC, for the U.S. Department of Energy under contract DE-AC05-00OR22725.

2:30PM S8.00006 Evolutionary Tracks for Betelgeuse1, MICHELLE DOLAN, GRANT MATHEWS, University of Notre Dame, DAVID DEARBORN, Lawrence Livermore National Laboratory — We have constructed a series of quasi-hydrostatic evolutionary models for the M2 Iab supergiant Betelgeuse ($\alpha$ Orionis). Our models are constrained by the observed temperature, luminosity, surface composition and mass loss for this star, along with recent parallax measurements and high resolution imagery which directly determine its radius. The surface convective zone obtained in our model naturally accounts for observed variations in surface luminosity and the size of detected surface bright spots. In our models these result from upflowing convective material from regions of high temperature in a surface convective zone. We also account for the observed periodic variability as the result of the effective equation of state in a simple linear pulsation model. Based upon a comparison between the accumulated mass loss in the observed circumstellar shell, and the lower limit on luminosity we suggest that this star most likely has a mass of either $16 \pm 2$ $M_{\odot}$ if a Reimers lass loss rate applies or $20 \pm 2$ for the de Jager mass loss rate. For any mass loss rate the star must be close to the top of the first ascent up the giant branch.

1Work at Notre Dame is supported by DoE Nuclear Theory grant number DE-FG02-95ER40934. Work at Lawrence Livermore National Laboratory performed under the auspices of the U.S. Department of Energy under contract W-7405-ENG-48 and NSF grant PHY-9401636.

2:42PM S8.00007 Non-MHD gravity-driven Hamiltonian dynamo for driving astrophysical jets1, PAUL BELLAN, Caltech — Conservation of canonical angular momentum $P_\phi = m_\sigma \dot{\theta} + (2m)^{-1}q_\phi \psi(r, z, t)$ shows that charged particles are typically constrained to stay within a poloidal Larmor radius of a poloidal magnetic flux surface $\psi(r, z, t)$. However, more detailed consideration shows that particles with a critical charge to mass ratio can have zero canonical angular momentum and so be both immune from centrifugal force and not constrained to stay in the vicinity of a specific flux surface. Suitably charged dust grains can have zero canonical angular momentum and in the presence of a gravitational field will spiral inwards across poloidal magnetic surfaces toward the central object and accumulate. This accumulation results in a gravitationally-driven dynamo [1], i.e., a mechanism for converting gravitational potential energy into a battery-like electric power source.

2:54PM S8.00008 Nucleosynthesis Yields from the Explosion of Massive Stars, Carla Frolich, Enrico Fermi Institute, University of Chicago, T. Fischer, M. Liebendoerfer, F.-K. Thielemann, University of Basel, J.W. Truran, University of Chicago — The large number of recent abundance observations in metal-poor stars and the progressing field of galactic evolution pose a need for improved predictions of nucleosynthesis yields from core collapse supernovae. The innermost ejecta and especially the Fe-group nuclei are directly affected by the explosion mechanism. Induced explosion models employing a piston or thermal bomb fail to predict the observed yields because the effects of neutrino interactions are not included. However, comprehensive core collapse supernova simulations are a complex and long standing problem. Despite continuous improvement they still bear important uncertainties. We will present detailed nucleosynthesis yields based on a model for the supernova ejecta featuring accurate Boltzmann neutrino transport and detailed neutrino-matter interaction in the nuclear network. The results will be confronted with recent observations of metal-poor stars and their impact on Galactic chemical evolution will be addressed.

3:06PM S8.00009 The lowest-mass stellar black holes: catastrophic death of neutron stars in gamma-ray bursts, Richard O’Saughnessy, Penn State University, Kristof Belczynski, Los Alamos National Lab, Vassiliki Kalogera, Northwestern University, Fred Rasio, Ron Taam, Thomas Bulik — Mergers of double neutron stars are considered the most likely progenitors for short gamma-ray bursts. Indeed such a merger can produce a black hole with a transient accreting torus of nuclear matter and the conversion of the torus mass-energy to radiation can power a gamma-ray burst. Using available binary pulsar observations supported by our extensive evolutionary calculations of double neutron star formation, we demonstrate that the fraction of mergers that can form a black hole — torus system depends very sensitively on the (largely unknown) maximum neutron star mass. We show that the available observations and models put a very stringent constraint on this maximum mass under the assumption that a majority of short gamma-ray bursts originate in double neutron star mergers. Specifically, we find that the maximum neutron star mass must be within 2–2.5 Msun. Moreover, a single unambiguous measurement of a neutron star mass above 2.5 Msun would exclude double neutron star mergers as short gamma-ray burst progenitors.

Monday, April 14, 2008 1:30PM - 3:06PM — Session S9 DPP: Inertial Confinement and High Energy Density Plasma

1:30PM S9.00001 Hydrodynamic Jet Experiments at LLE, J.P. Knauer, S. Sublett, R.S. Craxton, T.J.B. Collins, I.V. Igumenshchev, D.D. Meyerhofer, A. Frank, University of Rochester, R.P. Drake, University of Michigan — Observed jet and jet-like morphologies range from highly collimated flows associated with young stellar objects and active galactic nuclei to less-collimated flows associated with planetary nebulae. A technique, where seven beams from the OMEGA laser are incident onto a mid-Z plug embedded in a tungsten washer and two beams are used to generate x rays for radiography, is used to study jet outflows. An adiabatic model1 best describes jet propagation. Episodic flows are created using double-pulse laser irradiation and show a different jet structure with more material along the jet stem. Episodic experiments have been designed for the OMEGA EP Laser System where the time between outflows can be made comparable to the hydrodynamic evolution time. 2-D Eulerian hydrodynamic simulations both model OMEGA and design OMEGA EP experiments.1 E. C. Ostro et al., ApJ 557, 443 (2001). This work was supported by the U.S. Department of Energy Office of Inertial Confinement Fusion under Cooperative Agreement No. DE-FC52-08NA28302.

1:42PM S9.00002 Isochoric heating of matter by laser-accelerated high-energy protons, Julien Fuchs, Ana Mancic, Jerome Robiche, Patrizio Antici, Livia Lancia, Patrick Audebert, Luli CNRS, France, Patrick Combis, Patrick Renaudin, DPTA, CEA/DAM-Ile-de-France, France, Tomoaki Kimura, Ryouiske Kodama, Motoaki Nakatsusumi, ILE, Osaka University, Japan — Producing matter at a high temperature (1-25 eV) and solid density is of prime interest for fundamental plasma physics or ICF. The use of laser-based high energy proton beams to achieve such state of matter is interesting since they are short (< 1 ps) and they deposit their energy volumetrically; thus can heat, before they expand, much thicker samples than allowed using laser-heating. We performed, using two intense short pulses of the LULI 100 TW facility, experiments to characterize the achieved state of matter, coupled to a detailed hydro-modeling. A laser-generated proton beam irradiated and heated a secondary target positioned after a vacuum gap. Three diagnostics were used: (i) 1D time-resolved optical self-emission of the heated target rear-surface at two wavelengths, (ii) time-resolved interferometry of a chirped probe beam reflecting off the heated target rear-surface, (iii) x-ray absorption spectroscopy through the heated target using a laser-produced backlighter detecting its Ka-edge softening.

1:54PM S9.00003 Breakeven Fusion in a Staged Z-Pinch1, H.U. Rahman, Univ. CA, Irvine, P. Ney, Mt. San Jacinto College, N. Rostoker, F.J. Wessel, Univ. CA, Irvine — We are studying a dense-plasma, Z-pinch configuration, where a cylindrical, Xe shell implodes onto a co-axial, deuterium-tritium target. The configuration is modeled using Mach2. During implosion current amplification occurs at the outer surface of the DT target, leading to a shorter and more energetic implosion (Ref. 1). Shocks preheat and preaccelerate the DT without Rayleigh-Taylor (RT) instability (Ref. 2), even as the Xe liner becomes RT unstable. Proper choice of the initial radius, density, and driver parameters provides a fusion-energy yield larger than the stored (capacitor-bank) energy. A specific example is presented, involving a 2 MJ, 100 ns system that produces a 5 MJ fusion yield. These studies are of interest, since fusion breakeven has yet to be demonstrated in any laboratory experiment.

2:06PM S9.00004 Hot Electron and X-ray Production from Intense Laser Irradiation of Wavelength-scale Polystyrene Spheres, T. Ditmire, H.A. Sumuruk, S. Kneip, D.R. Symes, I.V. Churina, A.V. Belolipet-Ski, G. Dyer, A. Bernstein, University of Texas, T.D. Donnelly, Harvey Mudd College — In an attempt to control the electric fields at the surface of a high intensity solid target we have studied hot electron generation and x-ray production from targets coated with microspheres. This work is motivated by the possibility the achieved state of matter is comparable to the wavelengths of the incident laser radiation can result in electric field enhancements through well known Mie resonances. This local field enhancement can then lead to more efficient electron generation. We investigated hard x-ray (above 100 keV) generation from copper and fused silica targets coated with a monolayer covering of polystyrene microspheres. We performed the experiment using the 20 TW THOR laser system at the University of Texas. We frequency doubled the laser to improve temporal contrast and irradiated the spheres with 400 nm pulses at an intensity of 2 x 1017 W/cm2. Hard X-ray emission from the plasma was observed using filtered NaI scintillation detectors and K-alpha emission was measured with a Von Hamos spectrometer. We illuminated polystyrene spheres of diameters 0.1 - 2.0 microns on a glass substrate, with the 400 nm 100fs pulse, and find that there is a clear Mie enhancement in the field and hot electron generation for a specific range of sphere sizes.

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1 Funded by U.S. Department of Energy.
2:18PM S9.00005 Intense laser-driven electrostatic shocks and its acceleration of ions in over-dense plasmas QUANLI DONG, MINQING HE, ZHENMING SHENG, YUTONG LI, JIE ZHANG, High Energy Density Physics Group, Institute of Physics, CAS — The formation and propagation of the electrostatic shocks in over-dense plasmas irradiated by intense ultrashort laser pulses is studied with particle-in-cell simulations. The dependence of the initial shock speeds on the parameters of the plasma and the laser is explained by invoking the modified momentum conservation model with 2D effects taken into account. The details of the acceleration process of ions by the shocks are also investigated. Such topic is believed as an important issue in the fast ignition scheme of the inertial confinement fusion researches.

2:30PM S9.00006 Measuring Ultrasonic Dynamics in a Dense Plasma, I.V. CHURINA, B. CHO, A.C. BERNSTEIN, T. DITMIERE, The Texas Center for High Intensity Laser Science, Department of Physics, University of Texas, Austin — Transient effects were measured in free standing thin film (200-400 nm) following direct femtosecond laser heating at 1-10x10^14W/cm^2. Ultrasonic electron-ion equilibration dynamics in the dense plasma were studied with a single-shot measurement of the time-dependent reflectivity and phase shift at the rear surface. The measurement revealed the dynamics of heat and shock waves on the picosecond time scale with sub-picosecond resolution. The experimental results were compared to the calculated reflectivity and phase shift derived from the output parameters (electron density and dc electron conductivity) of hydrodynamic simulations. We simulated our experiments using different equation of states and ionization models in the HYADES hydrodynamic code. Our experimental results allowed us to test the currently available models.

2:42PM S9.00007 On the Baronova-Stepanenko X-ray crystal spectropolarimeter, NINO PEREIRA, Ecpulse — A few years ago Baronova and Stepanenko realized that the two orthogonal X-ray polarizations can reflect in mutually perpendicular direction from hexagonal crystals, and other crystals with the necessary symmetry. This paper will discuss their geometry, and the advantages it may have for diagnosing anisotropic effects in high energy density plasmas, e.g., non-Maxwellian electron beams or electromagnetic fields. Any results obtained with a prototype crystal will be presented.

2:54PM S9.00008 Transient Formation of keV Super-Explosives under High Pressure for Thermonuclear Ignition, FRIEDWARDT WINTERBERG, University of Nevada Reno — At pressures of the order 100 Mb, chemical reactions at keV energies can take place, leading to molecular configurations through the binding of the inner electron shells. For this reason, matter suddenly put under high pressure can form a super-explosive, which releases intense bursts of keV-X ray photons, powerful enough for the ignition of thermonuclear reactions.

1Research was not supported by any outside organization

Monday, April 14, 2008 1:30PM - 2:54PM -
Session S10 GGR DAP: Gravitational Waves Sources for LISA
Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis A

1:30PM S10.00001 The Mock LISA Data Challenges: status, achievements, and prospects, MICHELE VALLISNERI, Jet Propulsion Laboratory, California Institute of Technology, MOCK LISA DATA CHALLENGE TASKFORCE TEAM — The Mock LISA Data Challenges are a program to demonstrate and encourage the development of data-analysis capabilities for LISA, the planned NASA–ESA space-based gravitational-wave detector. Each round of challenges consists of several data sets containing simulated instrument noise and gravitational waves from sources of undisclosed parameters. Participants are asked to analyze the data sets and report the maximum information they can infer about the source parameters. The challenges are being released in rounds of increasing complexity and realism, and so far they have already demonstrated the recovery of model signals from nonspinning supermassive black-hole binaries, from ~ 20,000 overlapping Galactic white-dwarf binaries, and from the extreme–mass-ratio inspirals of compact objects into central galactic black holes. Challenge 3, currently in progress, includes signals from spinning supermassive black-hole inspirals, from cosmic-string cusps, and from primordial stochastic backgrounds. We discuss the status, achievements, and prospects of the Challenges.

1:42PM S10.00002 Inspirals of point particles into black holes via two-timescale, TANJA HINDERER, EANNA FLANAGAN, Cornell University — The inspiral of stellar mass compact objects into massive black holes are an important source for future gravitational wave detectors such as LISA and Advanced LIGO. Detection of these sources and extracting information from the signal relies on accurate theoretical models of the binary dynamics. We analyze this problem using a two-timescale expansion, which provides a rigorous derivation of the prescription for computing the leading order waveform. As shown by Mino, this leading order waveform, which we call the adiabatic waveform, requires only the radiative self force. The two-timescale method also lays the foundations for calculating the post-adiabatic corrections needed for measurement templates. We show that the leading order post-adiabatic corrections (terms in the phase that scale as the square root of the mass ratio) are due to transient resonances that occur during an inspiral when the ratio of the radial and azimuthal frequencies is a low order rational number. This effect is not seen in post-Newtonian expansions. At the next, subleading order (order unity terms in the phase), there are phase corrections due to the conservative and dissipative pieces of the first order self force, and the dissipative piece of the second order self force. The resonant phase shifts depend on the subleading order terms. Therefore, going beyond the adiabatic approximation would require computation of the dissipative piece of the second order self force.

1:54PM S10.00003 Gravitational waves from extreme mass ratio inspirals: Preliminary results from a hybrid approach to generate adiabatic waveforms, PRANESH SUNDARARAJAN, MIT, GAURAV KHANNA, University of Massachusetts - Dartmouth, SCOTT HUGHES, MIT, STEVE DRASCO, JPL — Extreme mass ratio inspirals (in which a stellar mass compact object perturbs a massive black hole spacetime) are an important source of gravitational radiation. We present preliminary results from a hybrid time-frequency domain approach to solve the Teukolsky perturbation equation and thus generate adiabatic waveforms from such inspirals. Recently, we have developed a code which treats the Teukolsky equation as a (2+1) PDE and solves it in the time domain. The key feature of this code is its ability to generate waveforms corresponding to any spacetime trajectory of the point-like compact object. A Fourier decomposition of the Teukolsky equation is possible when the compact object is constrained to a bound geodesic. The radiated fluxes from such a Fourier mode based frequency-domain code can be used to construct an adiabatic inspiral trajectory for the smaller object. Combining the accuracy of this frequency-domain trajectory with the versatility of the time-domain code allows us to generate adiabatic waveforms.

2:06PM S10.00004 The spectral signature of extreme mass ratio inspirals, STEVE DRASCO, Jet Propulsion Laboratory, California Institute of Technology — I describe the spectral signature of adiabatic inspirals of stellar mass compact objects into much larger rotating black holes. Simulated spectral snapshots of these systems (valid for a fraction of expected observation times, but for many orbit cycles) are generally composed of lines that can be grouped into around ten families defined by fixing two of the orbit’s three integer frequency multipliers. These mode families are fairly easy to predict from the geometry of the orbit, and inspiral simulations suggest that they are essentially fixed throughout the course of an inspiral. A hypothetical detection algorithm that tracks mode families dominating the first twelve hours of an inspiral would capture 98% of the total power over the remaining three years before merger. I will discuss the observation potential for simplistic detection schemes which are designed around these results and which are capable of recovering the adiabatic evolution of the inspiral’s orbit geometry.
2:18PM S10.00005 Math for Mapping Spacetime

JEANDREW BRINK, Caltech — One of the important science objectives for LISA is to quantitatively map the strong field regions around compact objects using Extreme-Mass-Ratio Inspirals (EMRIs). While this idea has been shown to be possible in principle, in practice only inspirals in a Kerr spacetime have been studied in detail. A spacetime mapping algorithm for an EMRI insprial into generic compact object is formulated using ideas from integrable systems. Aspects of theoretical development required to make a mathematical spacetime mapping machine an implementable reality are discussed.

2:30PM S10.00006 Estimating the computational efficiency of frequency– and time–domain calculations of gravitational waveforms from EMRIs

JONATHAN L. BARTON, DAVID J. LAZAR, University of Alabama in Huntsville, GAURAV KHANNA, University of Massachusetts Dartmouth, DANIEL J. KENNEFICK, University of Arkansas, LIOR M. BURKO, University of Alabama in Huntsville — We estimate the computation time for the frequency-domain (FD) calculation of gravitational-wave fluxes and waveforms for EMRIs modeling a compact object in an equatorial orbit around a super-massive black hole. We determine the number of \( k \) modes (associated with harmonics of the orbital radial frequencies) necessary to achieve a desired accuracy for each \( m \) mode (associated with harmonics of the azimuthal frequencies) for orbits of varying eccentricity. We then model the time required to compute single \( k \) modes and then find the computation time to sum over all the \( k \) modes for a given accuracy level. Next, we compute the energy flux and the waveform in the time domain (TD), and estimate the computation time required to achieve the same accuracy level for the same orbital parameters, and estimate the parts of the parameter space for which the TD approach becomes computationally more efficient than the FD method. We plan to extend this study also to non-equatorial and finally generic Kerr orbits.

1Supported by NASA/GSFC NCC5–580 and Stennis NNX07AL52A

2:42PM S10.00007 Black hole quasi-normal mode spectroscopy with LISA

MANISH M. JADHAV, LIOR M. BURKO, University of Alabama in Huntsville — We present an improved estimate of the signal-to-noise ratio (SNR) for the gravitational waves from the ring-down phase of coalescing black hole binaries for the NASA/ESA space-borne mission LISA. The usual all-sky average assumption is relaxed. We replace the usual averages of the spin-weighted spherical harmonics and physical and geometrical variables by Monte Carlo values, that are computed randomly for detector—source directions, black hole orientations, polarization state, phases, etc. E.g., for a given “radiation efficiency” \( \epsilon_{ij}^a \) we use a randomly generated “radiation efficiency per polarization state” \( \epsilon_{ij}^{a1} \), that reflects our ignorance of the polarization state of a typical source. We then estimate the non–angle–averaged, polarization and phase dependent SNR for both Schwarzschild and Kerr black holes, and determine by how much they differ from their all–sky averages as a function of the population sizes.

1Supported in part by grants NASA/GSFC NCC5–580 and NASA/Stennis NNX07AL52A

Monday, April 14, 2008 1:30PM - 3:18PM — Session S11 DPF: Searches I

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis B

1:30PM S11.00001 ABSTRACT WITHDRAWN

1:42PM S11.00002 Search for Large Extra Spatial Dimensions in Events with a Photon and Missing Transverse Energy Using the D0 Detector

EDGAR CARRERA, Florida State University, D0 COLLABORATION — A final state containing a high \( E_T \) photon and large missing transverse energy, although challenging experimentally, is quite interesting. Observation of an excess of such events compared to the Standard Model prediction could indicate, for example, existence of large extra spatial dimensions or anomalous ZZ couplings. We will present the latest DZero results for this final state.

1:54PM S11.00003 CMS Search Plans for Dijet Resonances

JANE NACHTMAN, University of Iowa, CMS COLLABORATION — New particles decaying to two partons can produce large dijet resonance signals at the LHC. The dijet mass distribution at CMS is sensitive to the rate of strongly produced resonances in a previously unexplored mass region. The expected dijet mass resolution at CMS is presented. The dijet ratio is sensitive to the decay angular distribution of dijet resonances, and therefore also to resonance spin. The optimum pseudorapidity interval for these measurements is discussed. The expected sensitivity using the dijet mass distribution and the dijet ratio with 100 pb\(^{-1}\) of integrated luminosity is explored.

2:06PM S11.00004 CMS Search Plans for Contact Interactions Using Jets

DAVID MASON, Fermilab, CMS COLLABORATION — Contact interactions arising from quark compositeness or other sources of physics beyond the standard model can produce large signals in jet events at LHC. The inclusive jet transverse momentum distribution is sensitive to an unexplored contact interaction scale \( \Lambda \) with only 10 pb\(^{-1}\) of integrated luminosity. Studies of the jet response versus pseudorapidity at CMS are presented. Uncertainties due to jet energy scale and parton distributions of the proton are discussed. With the dijet ratio CMS 5 will search for the effects of a contact interaction in dijet angular distributions. Sensitivity to \( \Lambda \) for integrated luminosities of 10 pb\(^{-1}\), 100 pb\(^{-1}\), and 1 fb\(^{-1}\) are presented.

2:18PM S11.00005 Large Extra dimensions in the ATLAS detector

ESTEBAN FULLANA TORREGROSA, Argonne National Laboratory, ATLAS COLLABORATION — Large Extra dimensions in the ATLAS detector E. Fullana Argonne National Laboratory One of the open questions in the Standard Model is the seventeen orders of magnitude difference between the Planck scale and the electroweak scale. Theories of large extra dimensions explain the apparent weakness of gravitational interaction by the leakage of gravitons through extra spatial dimensions. These theories predict that gravity could play an important role at colliders when the energy scale is above the TeV scale. The ATLAS experiment is one of the four experiments at the LHC, which is the new 14 TeV proton proton collider being commissioned at CERN (Geneva, Switzerland). The determination of the jet energy scale and its uncertainty is a milestone along the path to discovery of such signals. We describe the process to determine and validate the jet energy scale and its effect on extra dimensions signatures.

1Argonne National Laboratory’s work was supported by the U.S. Department of Energy, Office of Science, Office of Science, under contract DE-AC02-06CH11357

2:30PM S11.00006 ABSTRACT WITHDRAWN
2:42PM S11.00007 Search for High-Mass Resonances Decaying into Leptons of Different Flavor, YANJUN TU, ANADI CANEPA, NIGEL LOCKYER, University of Pennsylvania, PAVEL MURAT, Fermilab, CDF COLLABORATION — We present a search for high-mass resonances decaying into two leptons of different flavor: $\nu\mu$, $e\tau$ and $\mu\tau$. These resonances are predicted by several models beyond the Standard Model, such as the R-parity-violating MSSM. The search is based on $1 fb^{-1}$ of Tevatron Run II data collected with the CDF detector at $\sqrt{s} = 1.96$ TeV in proton-antiproton collisions.

2:54PM S11.00008 Search for a New Massive Boson $Z'$ with Di-muon Data at CDF, OLIVER STELZER-CHILTON, CHRIS HAYS, University of Oxford, CDF COLLABORATION — We present a measurement of the Drell-Yan mass spectrum at high energies in the dimuon channel using $2 fb^{-1}$ of proton-antiproton collision data taken with the CDF II detector at a centre of mass energy of 1.96 TeV. We examine this mass spectrum for any excesses over Standard Model predictions and to search for new neutral massive bosons such as $Z'$ decaying to two muons.

3:06PM S11.00009 Search for non-standard model top antitop resonance production in the all-hadronic channel at CDF, YURI OKSUZIAN, University of Florida, CDF COLLABORATION — We present the first result of a novel search for resonant top-antitop pair production and subsequent decay in the all-hadronic channel. We examine the top-antitop invariant mass spectrum observed in CDF II data from 1.9 TeV proton-antiproton collisions at Fermilab Tevatron. A narrow resonance state decaying to a top-antitop pair will appear as a “bump” in the observed mass spectrum. We apply a powerful reconstruction technique where the observed event kinematics are constrained according to the full standard model top-antitop production and decay matrix element. This technique provides excellent mass resolution. Also, probability densities from the per-event matrix element calculation are used as discriminants to reduce and control the large backgrounds of the all-hadronic channel.

Monday, April 14, 2008 1:30PM - 2:54PM

Session S12 DPB: Accelerator Physics

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis C

1:30PM S12.00001 Proton Linac Front End for High Intensity Neutrino Source at Fermilab, WAI-MING TAM, GIORGIO APOLLINARI, ROBYN MADRAK, ALFREDO MORETTI, LEONARDO RISTORI, GENNADY ROMANOV, JAMES STEIMEL, ROBERT WEBBER, DAVID WILDMAN, Fermilab — Fermilab has recently proposed the construction of an 8 GeV superconducting linac for the exploration of the high intensity frontier. The High Intensity Neutrino Source (HINS) R&D program was established to explore the feasibility of certain technical solutions proposed for the front end of a high intensity linac. The low energy (~60 MeV) section operates at 325 MHz and comprises an RFQ, two re-buncher cavities, 16 room temperature (RT) and 29 superconducting cross-bar H-type resonators, and superconducting solenoid focusing elements. One of the distinguishing features of this linac is the use of one klystron to feed multiple radio frequency (RF) elements. As an example, the RFQ, the re-bunchers and the 16 RT cavities are powered by a single 2.5 MW pulsed klystron. To achieve individual control over the phase and the voltage amplitude, each of the RF elements is equipped with a high power vector modulator. The RF control system will be discussed. The first RT cavity is completed with a power coupler, two mechanical tuners, vacuum and cooling systems, and has been RF conditioned. Preliminary tests on resonance frequency stability control and tests results of the cavity resonance frequency response to cooling water temperature and tuner position will also be discussed.

1:42PM S12.00002 Experimental verification of predicted oscillations near a spin resonance, V.S. MOROZOV, A.W. CHAO, A.D. KRISCH, M.A. LEONOVA, R.S. RAYMOND, D.W. SIVERS, V.K. WONG, University of Michigan, Ann Arbor, MI 48109-1040, A. GARISHVILI, R. GEBEL, A. LEHRACH, B. LORENTZ, R. MAIER, D. PRASUHN, H. STOCKHORST, D. WELSC, Forschungszentrum Jülich, IKP, D-52425 Jülich, F. HINTERBERGER, K. ULBRICH, Helmholtz Inst., Univ. Bonn, D-53115 Bonn, A. SCHNASE, JAEA/J-PARC, Tokai-Mura, Ibaraki 319-1195, Japan, E.J. STEPHENSON, IUCF, Indiana Univ., Bloomington, IN 47408-0768, N.P.M. BRANTJES, C.J.G. ONDERWATER, M. DA SILVA, Univ. of Groningen, the Netherlands — The Chao formalism allows analytic calculations of a beam’s polarization behavior inside a spin resonance. We recently tested its prediction of polarization oscillations occurring in a stored beam of polarized particles near a spin resonance. Using a 1.85 GeV/c polarized deuteron beam stored in COSY, we swept a new rf solenoid’s frequency rather rapidly through 400 Hz during 100 ms, while varying the distance between the sweep’s start and the central frequency of the rf-produced spin resonance. Our measurements of the deuteron’s polarization near and inside the resonance agree with the Chao formalism’s predicted oscillations.

1:54PM S12.00003 RF spin resonance strength for stored polarized deuterons, M.A. LEONOVA, A.D. KRISCH, V.S. MOROZOV, R.S. RAYMOND, D.W. SIVERS, V.K. WONG, J.M. WILLIAMS, University of Michigan, Ann Arbor, MI 48109-1040, A. GARISHVILI, R. GEBEL, A. LEHRACH, B. LORENTZ, R. MAIER, D. PRASUHN, H. STOCKHORST, D. WELSC, Forschungszentrum Jülich, IKP, D-52425 Jülich, F. HINTERBERGER, K. ULBRICH, Helmholtz Inst., Univ. Bonn, D-53115 Bonn, A. SCHNASE, JAEA/J-PARC, Tokai-Mura, Ibaraki 319-1195, Japan, A.M. KONDRATENKO, G.O. Zaryad Novosibirsk, 630058 Russia, E.J. STEPHENSON, IUCF, Indiana Univ., Bloomington, IN 47408-0768, N.P.M. BRANTJES, C.J.G. ONDERWATER, M. DA SILVA, Univ. of Groningen, the Netherlands — We studied the ratio of the measured to predicted rf spin resonance strengths $\epsilon_{FS}/\epsilon_{Bdl}$ for an rf dipole and an rf solenoid using 1.85 GeV/c vertically polarized deuterons at COSY. We measured $\epsilon_{FS}$ for fitting spin-flipping data to the Froissart-Stora equation, and we calculated each $\epsilon_{Bdl}$ from each rf magnet’s $B_{dl}$. We found no dependence on the beam’s momentum spread or the rf frequency sweep range for either the rf dipole or solenoid. We saw an enhancement of $\epsilon_{FS}/\epsilon_{Bdl}$ for an rf dipole and an rf solenoid using 1.85 GeV/c vertically polarized deuterons at COSY. We measured $\epsilon_{FS}$ for fitting spin-flipping data to the Froissart-Stora equation, and we calculated each $\epsilon_{Bdl}$ from each rf magnet's $B_{dl}$. We found no dependence on the beam's momentum spread or the rf frequency sweep range for either the rf dipole or solenoid. We saw an enhancement of $\epsilon_{FS}/\epsilon_{Bdl}$ for an rf dipole and an rf solenoid using 1.85 GeV/c vertically polarized deuterons at COSY. We measured $\epsilon_{FS}$ for fitting spin-flipping data to the Froissart-Stora equation, and we calculated each $\epsilon_{Bdl}$ from each rf magnet’s $B_{dl}$. We found no dependence on the beam's momentum spread or the rf frequency sweep range for either the rf dipole or solenoid. We saw an enhancement of $\epsilon_{FS}/\epsilon_{Bdl}$ for an rf dipole and an rf solenoid using 1.85 GeV/c vertically polarized deuterons at COSY. We measured $\epsilon_{FS}$ for fitting spin-flipping data to the Froissart-Stora equation, and we calculated each $\epsilon_{Bdl}$ from each rf magnet's $B_{dl}$. We found no dependence on the beam's momentum spread or the rf frequency sweep range for either the rf dipole or solenoid. We saw an enhancement of $\epsilon_{FS}/\epsilon_{Bdl}$ for an rf dipole and an rf solenoid using 1.85 GeV/c vertically polarized deuterons at COSY. We measured $\epsilon_{FS}$ for fitting spin-flipping data to the Froissart-Stora equation, and we calculated each $\epsilon_{Bdl}$ from each rf magnet's $B_{dl}$. We found no dependence on the beam's momentum spread or the rf frequency sweep range for either the rf dipole or solenoid. We saw an enhancement of $\epsilon_{FS}/\epsilon_{Bdl}$ for an rf dipole and an rf solenoid using 1.85 GeV/c vertically polarized deuterons at COSY. We measured $\epsilon_{FS}$ for fitting spin-flipping data to the Froissart-Stora equation, and we calculated each $\epsilon_{Bdl}$ from each rf magnet's $B_{dl}$.

2:06PM S12.00004 High Power Proton Beams Generated with the Z-Petawatt Laser, MATTHIAS GEISSEL, B.W. ATHERTON, P.K. RAMBO, J. SCHWARZ, Sandia National Laboratories, E. BRAMBRINK, M. SCHOLLMEIER, J. SCHÜTTTRUMPF, M. ROTH, Darmstadt University of Technology, K. FLIPPO, S. GAILLARD, M. HEGELICH, Los Alamos National Laboratory, J. GLASSMAN, Southern Illinois University — The Z-Petawatt laser system has been built up in stages over the last few years. It has been used to generate and characterize ion beam emission from solid density targets. These experiments addressed radiography and energy deposition on secondary targets, partly to be applied at the Z-Accelerator facility at Sandia National Laboratories as the capabilities of Z-Petawatt evolve. Cu, Al, Pd and Au targets were used for Target-Normal-Sheath Acceleration of protons and heavier ions. Results from parametric studies on target edge emission will be presented along with experiments on ballistic and magnetic proton beam focusing.

1Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy National Nuclear Security Administration under contract DE-AC04-94AL85000.
2LULI - Ecole Polytechnique
3Los Alamos National Laboratory
2:18PM S12.00005 Proton and ion beams generated with a CO2 laser¹, IGOR POGORELSKY, VITALY YAKIMENKO, IGOR PAVLISHIN, DANIL STOLYAROV, BNL, PETER SHKOLNIKOV, Stony Brook SUNY University, ALEXANDER PUKHOV, Inst. Theor. Physic I, Duesseldorf, PAUL MCKEANA, University of Strathclyde, Glasgow, ZULFIKAR NAJMUDDIN, LOUISE WILLINGALE, Imperial College, London, ELENA STOLYAROVA, GEORGE FLYNN, Columbia University, New York — The proton- and ion generation experiment is initiated at the BNL’s ATF where thin-foil targets are irradiated by a 1-TW, picosecond CO2 laser. A particle beam is produced in the normal direction to the foil’s rare surface. A spectrometer equipped with CR-39 dosimetry plates reveals proton- and ion spectra in the sub-MeV energy range. Comparison with results of previous experiments that used solid-state lasers allows for verification of wavelength scaling of the ion- and proton laser acceleration. We present simulations that lead the way toward further up-scaling of proton beam energy and luminosity in order to answer the demand for compact proton sources and injectors for scientific, medical and industrial applications.

¹This work is supported by the US Department of Energy.

2:30PM S12.00006 ABSTRACT WITHDRAWN —

2:42PM S12.00007 New Concepts and Fermilab Facilities for Antimatter Research, GERALD JACKSON, Hbar Technologies, LLC — There has been long significant interest in continuing antimatter research at the Fermi National Accelerator Laboratory. Beam kinetic energies ranging from 10 GeV all the way down to the eV scale and below are of interest. There are three physics missions currently being developed: the continuation of charmonium physics utilizing an internal target; atomic physics with in-flight generated antihydrogen atoms; and deceleration to thermal energies and passage of antiprotons through a grating system to determine their gravitation acceleration. Non-physics missions include the study of medical applications, tests of deep-space propulsion concepts, low-risk testing of nuclear fuel elements, and active interrogation for smuggled nuclear materials in support of homeland security. This paper reviews recent beam physics and accelerator technology innovations in the development of methods and new Fermilab facilities for the above missions.

Monday, April 14, 2008 1:30PM - 3:18PM —
Session S13 DPF: QCD and Colliders II Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis F

1:30PM S13.00001 Performance of Jet Algorithms at CMS, COSMIN DRAGOU, University of Illinois, Chicago, CMS COLLABORATION — The Compact Muon Solenoid (CMS) detector at the Large Hadron Collider (LHC) at CERN is designed to study a wide range of high-energy processes involving diverse signatures of final states. Almost every process of interest at LHC contains quarks and gluons in the final state which, through the fragmentation process, evolve into collimated spray of particles called jets. Jets are identified by clustering localized energy depositions in the CMS calorimeter detectors. Studies on the performance of the jet algorithms used at CMS will be presented.

1:42PM S13.00002 Measuring the Jet Energy Resolution at CMS: A Data-Driven Approach, AGATA SMORON, University of Illinois, Chicago, CMS COLLABORATION — The Compact Muon Solenoid (CMS) detector at the Large Hadron Collider at CERN is a general-purpose detector designed to study proton-proton collisions at a center-of-mass energy of 14 TeV. Many interesting physics signatures include jets in the final state. Jets are identified by clustering localized energy depositions in the CMS calorimeter detectors. Using a sample of dijet events, we have investigated methods for determining the jet energy resolutions in data as a function of jet’s transverse energy and pseudorapidity. Studies demonstrating the validity of these methods using Monte Carlo simulations will be presented.

1:54PM S13.00003 A Combined Tracking & Calorimetry Jet Energy Scale at D0, TYLER DORLAND, University of Washington, Seattle, D0 COLLABORATION — Currently, D0 jets from p-p(bar) collisions are reconstructed using the signals from a liquid Argon - Uranium sampling calorimeter. Previous work has shown an algorithm combining the precision of the D0 sampling calorimeter at high momenta and the precision of the magnetic tracker at low momenta can significantly improve the raw jet energy resolution. Using the framework of the current calorimeter-only jet energy scale at D0 a new track and calorimeter jet energy scale can be calculated so a direct comparison between the two methods can be made. The modifications of the calorimeter-only jet energy scale are reported, and the resultant improvement in jet energy resolution is demonstrated.

2:06PM S13.00004 Photon + Heavy Flavor Jet Production at D0, DANIEL DUGGAN, Florida State University, D0 COLLABORATION — A measurement of photon + b jet production is presented using about 1 fb^-1 of data collected by the D0 detector at the Tevatron p pbar collider at a center-of-mass energy of 1.96 TeV. Isolated photons are selected in the rapidity range 0 < |y| < 1.0 and the jets are selected using the D0 Midpoint Cone Algorithm in the rapidity ranges 0 < |y| < 0.8 or 1.5 < |y| < 2.5. The measurement is expected to help constrain the understanding of the b quark content of the proton.

2:18PM S13.00005 Study of Inclusive Prompt Photon Production at CDF, CAROLINA DELUCA, Institut de Fisica d’Altes Energies (IFAE-Barcelona), CDF COLLABORATION — We present preliminary results on inclusive prompt photon production based on 2 fb^-1 of CDF Run II data. The measurements are performed as a function of the transverse momentum and the pseudorapidity of the photon and are compared to pQCD predictions.

2:30PM S13.00006 Studying Hard Elastic NN Scattering in Isosinglet State¹, CARLOS GRANADOS, MISAK SARGSIAN, Florida International University — We analyze world data on high momentum transfer pp and pn scattering in order to extract the hard nucleon-nucleon elastic cross sections in isosinglet channel. These data provide us with new constraints in checking the QCD dynamics of elastic nucleon-nucleon scattering. Several aspects of this dynamics are studied, such as the evidence of the oscillations in the energy dependence of s^{10} weighted differential cross section of NN scattering at 90° center of mass scattering angles and extent of SU6 symmetry breaking in the quark wave function of the nucleon. Studying, both, angular and energy dependences of isosinglet NN cross section we attempted to constrain the contribution due to resonating scattering as well as independent gluon exchanges that could give rise the energy oscillations observed in pp scattering.

¹This research is supported by the Department of Energy grant.

2:42PM S13.00007 CMS Pixel Hit Reconstruction Using Cluster Templates and its Impact on Tracking and b-Tagging, DAVID FEHLING, Johns Hopkins, CMS COLLABORATION — We present a novel technique for reconstructing hits in the CMS pixel detector based on its the observed spatial charge distributions to the templates obtained from a detailed simulation. This technique suppresses resolution tails and provides cluster shape information that is useful in track seeding. We present the improvement this approach brings track reconstruction and the b-tagging using the baseline algorithms currently in use in CMS.
2:54PM S13.00008 Level 1 b-tagging Trigger Proposal for CMS . PATRICK TSANG, Brown University. CMS COLLABORATION — A study of b-tagging in CMS Level-1 triggers by simulated data is presented. Two muon momentum cuts, loose and tight, are proposed, which give a Level-1 b-tagging efficiency of 7.9% for jet $|p_T| < 2.5$, and 7.3% for jet $|p_T| < 2.0$ respectively. For an instantaneous luminosity of $L = 2 \times 10^{33}$ cm$^{-2}$s$^{-1}$ and the jet $p_T$ cut of 20 GeV jet $p_T$ cut 20GeV, we obtain an integrated background rate 3.8kHz for tight cut, and 5.7kHz for loose, which is a hundred times lower than 210kHz rate of a non-b-tag L1 trigger with the same jet threshold. The proposed trigger is now under consideration by the CMS collaboration.

3:06PM S13.00009 Jet and $E_T^{miss}$ Improvement Using Track Information in Atlas . ZACHARY MARSHALL, Columbia University. ATLAS COLLABORATION — We present a new technique that uses tracks to improve the energy resolution of calorimeter jets. The method relies on the fact that jet energy response depends on the jet particle composition, which can be determined, on a jet-by-jet bases, using track information. The new algorithm corrects the jet energy response as a function of the fraction of charged particle energy, defined as the ratio of track-jet over calorimeter-jet transverse momentum ($J_{trk}$). Preliminary studies with ATLAS full simulation show a 20% improvement in the fractional jet energy resolution with the new track-based energy response and an improvement in missing transverse energy scale. Future improvements include the use of additional track-based variables, like the fraction of transverse momentum carried by the leading track.

Monday, April 14, 2008 1:30PM - 2:54PM 
Session S16 FE: The Place of the Advanced Laboratory in Undergraduate Education Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Director039;s Row 29

1:30PM S16.00001 The AAPT Advanced Laboratory Task Force Report . JEFFREY DUNHAM, Middlebury College — In late 2005, the American Association of Physics Teachers (AAPT) assembled a seven-member Advanced Laboratory Task Force$^1$ to recommend ways that AAPT could increase the degree and effectiveness of its interactions with physics teachers of upper-division physics laboratories, with the ultimate goal of improving the teaching of advanced laboratories. The task force completed its work during the first half of 2006 and its recommendations were presented to the AAPT Executive Committee in July 2006. This talk will present the recommendations of the task force and actions taken by AAPT in response to them. The curricular goals of the advanced laboratory course at various institutions will also be discussed. The talk will conclude with an appeal to the APS membership to support ongoing efforts to revitalize advanced laboratory course instruction.$^1$ Members of the Advanced Laboratory Task Force: Van Bistrow, University of Chicago; Bob DeSerio, University of Florida; Jeff Dunham, Middlebury College (Chair); Elizabeth George, Wittenburg University; Daryl Preston, California State University, East Bay; Patricia Sparks, Harvey Mudd College; Gerald Taylor, James Madison University; and David Van Baak, Calvin College.

2:06PM S16.00002 The NASA/Olin Summer Internship Program . STEPHEN HOLT, Franklin W. Olin College of Engineering — In each of the past five summers, underclassmen at the Franklin W. Olin College of Engineering have worked in small teams under the mentorship of astrophysicists at NASA’s Goddard Space Flight Center. The experience of tackling authentic projects with strict schedule constraints has provided them with educational experiences that are quite different from what might be obtained in a classroom setting. Results from the perspectives of the Goddard mentors, the faculty advisors and the students will be presented.

2:18PM S16.00003 The Advanced Laboratory: beyond the “black box” to real physics . GEORGE ZIMMERMAN, Boston University, Emeritus. LAWRENCE SULAK, Boston University, Physics — The balance between theory and experiment in present physics curricula is too heavily weighted towards theory. Our physics majors do not realize that “truth in physics” depends either on experimental verification of theoretical predictions or on serendipitous discovery. Nor do they appreciate that most theories originate to explain experimental facts. They regard instruments as “black boxes” (although usually they are painted a different color). The Advanced Laboratory is essentially the only place in the curriculum where students confront the link between theory and experiment. In this age of disposing of (rather than repairing) equipment, Advanced Lab gives students insight into the inner workings of instruments and essential hands-on skills exploiting them: soldering wires, transferring cryo liquids, achieving high vacuum, acquiring reliable data, evaluating errors, fitting data, and drafting a PRL. Students learn techniques critical to several branches of physics, leading to different experimental approaches in their eventual work. If a student pursues theory, AdLab teaches her how to evaluate experiments, experimentalists, and their data. The basic skills learned, and the resulting understanding of physics, will be illustrated with the experiment on the Quantum Hall Effect from our AdLab.

2:30PM S16.00004 Development of Research Projects in Advanced Laboratory . PING YU, SUCHI GUHA, University of Missouri — Advanced laboratory serves as a bridge spanning primary physics laboratory and scientific research or industrial activities for undergraduate students. Students not only study modern physics experiments and techniques but also acquire the knowledge of advanced instrumentation. It is of interest to encourage students using the knowledge into research projects at a later stage of the course. We have designed several scientific projects for advanced laboratory to promote student’s abilities of independent research. Students work as a team to select the project and search literatures, to perform experiments, and to give presentations. During the research project, instructor only provides necessary equipment for the project without any pre-knowledge of results, giving students a real flavor of scientific research. Our initial attempt has shown some interesting results. We found that students showed a very strong motivation in these projects, and student performances exceeded our expectation. Almost all the students in our first batch of the course have now joined graduate school in Physics and Materials Science. In the future we will also arrange graduate students working with undergraduate students to build a collaborative environment. In addition, a more comprehensive method will be used to evaluate student achievements.

2:42PM S16.00005 Advanced Physics Labs at Sacramento State . WILLIAM DEGRAFFENREID, VASSILI SERGAN, GARY SHOEMAKER, California State University, Sacramento — The Department of Physics and Astronomy at Sacramento State has a long history of offering numerous upper division laboratories to our majors. Currently, we offer five laboratory classes, of which two are required, at the junior and senior level. In addition to what might be considered standard classes: Advanced Physics Lab, Electronics and Instrumentation, and Optics, we also offer courses in Acoustics and Advanced Electronics and Instrumentation. These labs have benefited by some fortunate circumstances, such as the inclusion of an 8700 cubic foot anechoic chamber in our building during its initial construction, as well as support from several instrumentation and display companies. We will review our facilities, curriculum, and future plans.

Monday, April 14 2008 2:06PM - 3:30PM 
Session S18 SPS: Undergraduate Session I Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Director039;s Row 46
2:06PM S18.00001 SPS Outstanding Student Award for Undergraduate Research Talk: Lifetime Measurements and Deformation in $^{79}$Sr, YUN KYOUNG RYU, ROBERT KAYE, S.R. ARORA, Ohio Wesleyan University, S.L. TABOR, Florida State University, J. DORING, Gesellschaft für Schwerionenforschung, Y. SUN, University of Notre Dame, T.D. BALDWIN, D.B. CAMPBELL, C. CHANDLER, M.W. COOPER, S.M. GERRICK, M. WIEDEKING, C.R. HOFFMAN, J. PAVAN, Florida State University, O. GRUBOR-URSOVIC, Purdue University Calumet, L.A. RILEY, Earlham College — High-spin states in $^{79}$Sr were produced following the $^{54}$Fe($^{28}$Si, 2$n$) fusion-evaporation reaction using a beam kinetic energy of 90 MeV at the Florida State University (FSU) Tandem-Linac particle accelerator facility, and the resulting de-exciting $\gamma$ rays were detected with the FSU array of 10 Compton-suppressed high-purity Ge detectors comprised of three Clover detectors and seven single-crystal detectors. The synthesized nuclei were stopped completely in the target, resulting in Doppler-shifted $\gamma$-ray line shapes that could be analyzed using the Doppler-shift attenuation method. The experimental line shapes were acquired at detection angles of 35˚ and 145˚, and the resulting Doppler-shifted peaks were analyzed to extract the lifetime of their parent states. In all, 23 lifetimes were measured in three separate band structures using this method, and then used to infer transition method. The experimental line shapes were measured in three separate band structures using this method, and then used to infer transition moments ($Q_1$) and quadrupole deformations ($\beta_2$) using the rotational model. The resulting $Q_1$ values indicated a high degree of collectivity and deformation in all three observed sequences of excited states (bands) with only a modest decline in collectivity with increasing angular momentum. The results show good qualitative agreement with the predictions of both cranked Woods-Saxon (CWS) and projected shell model (PSM) calculations. In addition, the pattern of excited energy states and their de-exciting gamma-ray transitions (level scheme) was re-examined and compared to the most recent study of $^{79}$Sr using $\gamma - \gamma$ coincidence measurements, intensity measurements, and directional correlation of oriented nuclei (DCO) ratios in addition to the lifetime measurements. Overall, the level scheme was verified, with the exception of the re-arrangement of one transition. The band based on the intrinsic $\epsilon_{5/2}$ single-particle orbital from the shell model, was found to have the largest average deformation ($\beta_2$,ave = 0.41) among the three observed bands, in agreement with the CWS and PSM theoretical predictions.

2:30PM S18.00002 Search for QCD Hawking Radiation in Heavy Ion Collisions, LAURA STILES, MICHAEL MURRAY, University of Kansas — A wide variety of measurements at RHIC, for example $v_2$ and energy loss, suggest that the partonic matter created in heavy ion collisions thermalizes early. One possible mechanism for this is the creation of the QCD analogue to gravitational black holes [1]. Such objects have no memory of their creation and radiate with a characteristic temperature, $T$, that can depend only on their energy, charge, and angular momentum. This hypothesis is consistent with the growth of multiplicity with $\sqrt{s}$ in e+e- collisions and thermal temperature observed at LEP. For central heavy ion collisions the angular momentum of the system is approximately zero and the model predicts a universal dependence of the chemical freezeout temperature on the ratio of charge to transverse energy. To test this prediction against BRAHMS data, we have fitted data on $\pi$, K, p and $\bar{p}$ from central Au + Au collisions at several rapidities and energies, using the THERMUS code. The experimental dependence of the temperature on the ratio of charge to transverse energy will be compared to the Hawking radiation predictions. By comparing data sets at different energy, centrality and rapidity we can select systems with the same ratio of baryon number to energy but different rapidities. This may allow us to test for any effect of angular momentum on temperature. [1] P. Castroina, D. Kharzeev and H. Satz, Eur. Phys. J. C 52, 187 (2007)

2:42PM S18.00003 Measuring the transverse position of forward neutrons at the Large Hadron Collider$^1$, NAVID TERHANI, ARADALAN DEHDASHTI, University of Kansas, CMS COLLABORATION — One way to study the quark-gluon matter produced in heavy ion collisions is to measure the deflection of very forward neutrons. In CMS this can be achieved with the Zero Degree Calorimeters, ZDCs, if we add a hodoscope of cerenkov or silicon detectors. The ideal position for such a detector is at shower maximum, i.e. the point where the number of secondary particles produced by the incoming neutrons is greatest. Fortunately for us this point is between the electromagnetic and hadronic parts of the ZDCs. Such an upgrade must be very compact and robust. I will describe a possible design for such a detector based on an 8$^*8$ grid of 1cm tiles and a multi-anode PMT. I will present a model of such a detector and give estimates of its performance.

$^1$DOE Office of Science and National Science Foundation.

2:54PM S18.00004 Neutron Flow at the Large Hadron Collider$^1$, JESSICA SNYDER, University of Kansas, CMS COLLABORATION — One of the most exciting recent results in high-energy nuclear physics is the discovery that nucleus-nucleus collisions at the Relativistic Heavy Ion Collider, RHIC, produce an almost perfect fluid of quarks and gluons. This state was identified thanks to the strong collective “flow” of particles observed. In 2009 the Large Hadron Collider, LHC, will study lead-lead collisions at an energy 28 times larger. At such high energies, it is possible that the collective properties of the produced matter resemble more that of a weakly interesting quark-gluon plasma rather than the liquid-like state observed at RHIC. This would result in a different flow strength. Flow measurements at the LHC can be carried out by measuring the pattern of spectator neutrons emitted along the beam axis, using two detectors inserted between the electromagnetic and hadronic sections of the CMS Zero Degree Calorimeters (ZDCs). I will present results of GEANT simulations of such a detector, including estimates of its capabilities to measure neutron flow.

$^1$DOE Office of Science and National Science Foundation.

3:06PM S18.00005 Accurate Energy Calibrations from Cosmic Ray Measurements$^1$, AMY DELINE, JOSEPH FINCK, Central Michigan University, ARTEMIS SPYROU, MICHAEL THOENENESSEN, MSU/NSCL, PAUL DEYOUIGN, Hope College, THE MONA COLLABORATION — The Modular Neutron Array, located at the NSCL at Michigan State University, is used in conjunction with the MSU/FSU Sweeper Magnet to study the breakup of neutron-rich nuclei. Fragmentation reactions create particle-unstable nuclei near the neutron drip-line which spontaneously break up by the decay of one or two neutrons with energies that reflect the nuclear structure of unbound excited and ground states. The neutrons continue forward into MoNA where their position and time are recorded, and the charged fragments' position and energy are measured by the array of detectors following the Sweeper Magnet. In such experiments it is important to be able to identify one-and two-neutron events hitting MoNA. For this reason an accurate energy calibration of the MoNA bars is crucial. The present work focuses on performing an energy calibration from cosmic ray measurements. The application of different gates on the cosmic ray spectra allowed the selection of events that correspond to different energy depositions in a MoNA bar, at energies between 18 and 32 MeV.

$^1$NSF PHY0555439, PHY0606007, PHY0354920

3:18PM S18.00006 CDMS Veto Stability Study and Calibration$^1$, GABRIEL CACERES, Augustana College — Most experiments searching for dark matter particles have been led deep underground to minimize the background produced by cosmic rays. The Cryogenic Dark Matter Search (CDMS) lies 1/2 mile underground in the Soudan Mine in Minnesota. Even though the muon rate is lowered by a factor of 10$^5$, the rate is still high enough to produce background signals. To solve this problem, scintillator panels have been placed around the detector to veto cosmic induced events. This work studies the behavior over time of the scintillator veto panels. By analyzing and tracking the response to a LED pulser system, the stability was determined to be within 3%. The absolute energy scale of the spectrum was then calibrated using radioactive sources, as well as the muon distribution. Knowing the absolute energy scale and where the veto trigger threshold lies provides useful information for calculating the amount of background that can be rejected.

$^1$Fermilab Summer Internships in Science and Technology
previous theoretical attempts at capturing this unusual phenomenon have not been successful. The lowest energy singlet surfaces for the reaction of \( \text{Al}^+ + \text{H}_2 \rightarrow \text{AlH}^+ + \text{H} \) in the threshold for the formation of \( \text{AlD}^+ \) and \( \text{HD} \) reactant whereas all other \( \text{AlH}^+ \) + \( \text{D}^+ \) products.\n
\[ \text{Vibrational mode } \sim \text{bound}. \] It was found that the product-forming reactions proceed very inefficiently. The experiments also showed a reduction of \( \sim 29\% \) in the threshold for the formation of \( \text{AlD}^+ \) from the HD reactant whereas all other \( \text{AlH}^+ \) + \( \text{D}^+ \) products formed at the same energetic threshold. Four previous theoretical attempts at capturing this unusual phenomenon have not been successful. The lowest energy singlet surfaces for the reaction of \( \text{Al}^+ \) with \( \text{H}_2 \) have been calculated at the multi-reference configuration interaction \( (\text{MRCI}) \) level of theory. The real/imaginary boundary of the symmetry-breaking \( b_2 \) vibrational mode was examined in three dimensions using Hessian matrices computed at a multi-configurational self-consistent field \( (\text{MCSCF}) \) level of theory.

Molecular dynamic simulations numbering on the order of \( 10^5 \) were performed, sampling initial conditions reflective of the experiments. The simulations were run until they reached the location where the \( b_2 \) vibrational mode became unbound. A dissociation model was applied at these greatly compressed geometries to model the dissociation into \( \text{AlH}^+ \) and \( \text{AlD}^+ \) products.

\[3:06PM S19.00006 \text{ The late–time tails in the Reissner–Nordström space-time revisited}^1, \text{ CARL J. BLAKSLEY, LIOR M. BURKO, University of Alabama in Huntsville — We propose that the late-time tail problem in the Reissner-Nordström (RN) spacetime is dual to a tail problem in the Schwarzschild spacetime with a different initial data set: at a fixed observation point the asymptotic decay rate of the fields are equal. This duality is used to find the decay rate for tails in RN. This decay rate is exactly as in Schwarzschild, including the case of the extremely-charged RN spacetime (ERN). The only case where any deviation from the Schwarzschild decay rate is found is the case of the tails along the event horizon of an ERN spacetime, where the decay rate is the same as at future null infinity. As observed at a fixed location, the decay rate in ERN is the same as in Schwarzschild. We verify these expectations with numerical simulations.}^1\]

\[\quad^1\text{CJB was supported by Research Experiences for Undergraduates in Science and Engineering sponsored by the ASGC under Contract NNG05GE80H and by the UAH President’s Office. LMB was supported by NASA/GSFC NCC5–580 and NASA/Stennis NNX07AL52A grants.}\]

\[3:06PM S19.00006 \text{ The late–time tails in the Reissner–Nordström space-time revisited}^1, \text{ CARL J. BLAKSLEY, LIOR M. BURKO, University of Alabama in Huntsville — We propose that the late-time tail problem in the Reissner-Nordström (RN) spacetime is dual to a tail problem in the Schwarzschild spacetime with a different initial data set: at a fixed observation point the asymptotic decay rate of the fields are equal. This duality is used to find the decay rate for tails in RN. This decay rate is exactly as in Schwarzschild, including the case of the extremely-charged RN spacetime (ERN). The only case where any deviation from the Schwarzschild decay rate is found is the case of the tails along the event horizon of an ERN spacetime, where the decay rate is the same as at future null infinity. As observed at a fixed location, the decay rate in ERN is the same as in Schwarzschild. We verify these expectations with numerical simulations.}^1\]

1Supported by NSF REU grant PHY-0552386 and research co-operative agreement PHY-0202078.

2:18PM S19.00002 \text{ ABSTRACT WITHDRAWN}\n
2:30PM S19.00003 \text{ Bio-Photons of Various Cellular Cultures and Tissues }^1, \text{ PATRICK HANN, ERNST KNOESE, MARIA GARZON, SAMUEL LOFLAND, ERIK PFIFFER, Rowan University — Since it is non-invasive, there has been increased research in the field of bio-optics. Many biological systems display an unusual phenomenon, delayed luminescence, produced by what is known as bio-photons. We present an apparatus and procedure for the detection of these ultra-weak photonic emissions using a single photon detection device. The results of bread yeast, sacramyces, and algae will be presented and compared to other reports in the literature.}^1

2:42PM S19.00004 \text{ Whispering-Gallery-Mode Resonances in FLourescent Microspheres}^1, \text{ MARY WILLIAMS, D. BRIAN THOMPSON, University of North Alabama — We are collecting emission spectra from fluorescent microspheres, aligned to form coupled cavities. A single fluorescent microsphere can act as a Fabry-Perot resonance cavity, so that it will exhibit morphology-dependent resonances (MDRs), also known as whispering gallery mode (WGM) resonances, as intense narrow peaks superimposed upon the free-space fluorescence emission background. Two or more microspheres in close proximity may form a coupled cavity, where the coupling arises from evanescent fields between the microspheres. The coupling strength then should be a strong function of separation distance between spheres. We use an optical tweezers to position the microspheres, to guide the excitation light, and to collect the emission from the microspheres for spectral analysis. The goal of these measurements is to examine the behavior of MDRs in the emission spectra of two coupled microspheres as separation distances are varied. However, at this stage in our work, we are examining how various dye-staining methods impact the spectra we collect.}^1

1Cottrell College Science Award from Research Corporation and Faculty Research Grants from the University of North Alabama

2:54PM S19.00005 \text{ Probing the Unusual Thresholds of AlH+/AlD+ formation by Molecular Dynamic Simulations on MRCl Potential Energy Surfaces }^1, \text{ NATHAN BREWER, Sigma Pi Sigma/SPS- Union University — In an experiment performed by P. Armentrout (Int. Rev. Phys. Chem. 1990, 9, 115), the Al\textsuperscript{+} cation was accelerated into the various isotopic combinations of \( \text{H}_2 \) to form \( \text{AlH}^+ \) and \( \text{AlD}^+ \). It was found that the product-forming reactions proceed very inefficiently. The experiments also showed a reduction of \( \sim 29\% \) in the threshold for the formation of \( \text{AlD}^+ \) from the HD reactant whereas all other \( \text{AlH}^+ \) and \( \text{AlD}^+ \) products formed at the same energetic threshold. Four previous theoretical attempts at capturing this unusual phenomenon have not been successful. The lowest energy singlet surfaces for the reaction of \( \text{Al}^+ \) with \( \text{H}_2 \) have been calculated at the multi-reference configuration interaction \( (\text{MRCI}) \) level of theory. The real/imaginary boundary of the symmetry-breaking \( b_2 \) vibrational mode was examined in three dimensions using Hessian matrices computed at a multi-configurational self-consistent field \( (\text{MCSCF}) \) level of theory. Molecular dynamic simulations numbering on the order of \( 10^5 \) were performed, sampling initial conditions reflective of the experiments. The simulations were run until they reached the location where the \( b_2 \) vibrational mode became unbound. A dissociation model was applied at these greatly compressed geometries to model the dissociation into \( \text{AlH}^+ \) and \( \text{AlD}^+ \) products.}^1

3:06PM S19.00006 \text{ The late–time tails in the Reissner–Nordström space-time revisited}^1, \text{ CARL J. BLAKSLEY, LIOR M. BURKO, University of Alabama in Huntsville — We propose that the late-time tail problem in the Reissner-Nordström (RN) spacetime is dual to a tail problem in the Schwarzschild spacetime with a different initial data set: at a fixed observation point the asymptotic decay rate of the fields are equal. This duality is used to find the decay rate for tails in RN. This decay rate is exactly as in Schwarzschild, including the case of the extremely-charged RN spacetime (ERN). The only case where any deviation from the Schwarzschild decay rate is found is the case of the tails along the event horizon of an ERN spacetime, where the decay rate is the same as at future null infinity. As observed at a fixed location, the decay rate in ERN is the same as in Schwarzschild. We verify these expectations with numerical simulations.}^1

1CJB was supported by Research Experiences for Undergraduates in Science and Engineering sponsored by the ASGC under Contract NNG05GE80H and by the UAH President’s Office. LMB was supported by NASA/GSFC NCC5–580 and NASA/Stennis NNX07AL52A grants.
2:06PM S20.00001 3D Quantitative Nanoscale Imaging via Coherent X-Rays1, KEVIN RAINES, CHANGYONG SONG, HUAIDONG JIANG, ADRIAN MANCUSCO, RUI XU, JIANWEI MIAO, Department of Physics and Astronomy, University of California, Los Angeles, CA 90095, CHIEN-CHUN CHEN, TING-KUO LEE, Institute of Physics, Academia Sinica, Nankang, Taipei, 11529, Taiwan, TETSUYA ISHIKAWA, RIKEN SPring-8 Center, 1-1-1, Kouto, Sayo, Hyogo 679-5148, Japan — Coherent x-ray diffraction microscopy (CXDM) promises to become an important imaging technique, particularly with the development of FELs. Indeed, recently there has been much interest in harnessing CXDM to quantitatively image in 3D such biological samples as single cells, organelles, and eventually macromolecules. Such images are obtained by rotating a specimen about an axis, resulting in its 3D diffraction pattern in cylindrical coordinates. Thus interpolating the data accurately onto a Cartesian grid is an essential step to 3D image reconstruction. We have developed a gridding-based interpolation scheme that yields a superior reconstruction from a limited and incomplete set of diffraction patterns. This interpolation algorithm is generalizable to a variety of imaging and interpolation applications. The effect of various degrees of angular under-sampling and the missing wedge upon resolution in each dimension will also be discussed.

1Supported by NSF, DOE, and RIKEN.

2:18PM S20.00002 Using a Large Ring Laser Gyroscope (RLG) to Understand the Torsional Components of Near-Field Seismic Events1, ADAM JACOBS, Hendrix SPS Chapter — Seismographs are able to accurately measure translational components of seismic events, i.e. the North-South, East-West, and Up-Down (z) components. However, there has recently been a renewed interest in measuring the torsional components of such events. Preliminary results from a triangular, large ring laser (measuring 17 meters on a side) suggest that RLGs could be a vital tool in opening up this relatively unexplored aspect of seismology. The ring laser has produced data similar to that of seismographs in response to three near-field earthquakes in Tennessee, the Gulf of Mexico, and Mexico. In addition to this, Fourier analysis of voltage variations caused by perturbations of the ring laser during these near-field events has yielded several interesting results not given by traditional seismographs. These results include the increased effectiveness of RLGs for near-field measurements versus far-field, the torsional resonances excited by the detected far-field, and perhaps the mechanism which generates torsion in an earthquake. The ring laser’s results, their implications, and a potential model will be presented.

1Gracious acknowledgement is due to the National Science Foundation and the Arkansas Space Grant Consortium.

2:30PM S20.00003 Chaos in the Relativistic Three-Body Problem, MIRIAM CONDE, J.J. CAMPBELL, DAVID TANNER, DAVID NEILSEN, Brigham Young University — We investigate chaos in general relativity by studying three-body interactions using the post-Newtonian formalism. The initial data consist of a binary pair (with equal or unequal masses) that scatters a third object that comes from infinity, and these data are parametrized by the orbital phase of the binary pair and the initial impact parameter of the third body. The final state of the system is characterized by quantities measurable at infinity, and we examine the sensitivity of these quantities on the initial parameters. Finally, we calculate Lyapunov exponents directly from the simulations to quantify the chaotic behavior.

2:42PM S20.00004 Relativistic Corrections and Chaos in the Three-Body Problem, J.J. CAMPBELL, DAVID NEILSEN, MIRIAM NEUBAUER, DAVID TANNER, Brigham Young University — In classical Newtonian gravity, the three-body problem is known to be chaotic for general initial data. We investigate the existence of chaos for the three-body problem in general relativistic using the first and second post-Newtonian approximations. Our initial data consists of a binary pair scattering from a binary pair and are parameterized by an impact parameter and phase angle. The Hamiltonian equations of motion are integrated using geometric methods and we extract gauge-independent quantities at infinity. We present results that characterize chaos in general relativity.

2:54PM S20.00005 Six degree-of-freedom thrust sensor for hybrid rocket, JOSHUA WILSON, Hendrix College — Thrust is the reactive force experienced by a rocket due to the ejection of high velocity matter. The Hybrid Rocket Facility at the University of Arkansas at Little Rock (UALR) uses strain gauges mounted to an s-beam to measure axial direction thrust of the rocket. A new six degree of freedom thrust sensor has been built for the UALR Hybrid Rocket Facility. The six degrees of freedom are the thrust force components in the three spacial directions (Fx, Fy, Fz) plus the three moments (roll, pitch, yaw). Even though the majority of the rocket’s thrust is in the axial direction, the components in the other directions are non-zero, and must be measured to account for the total work done by the rocket motor. The sensor design and fabrication are now complete. Calibration of the load cells on each of the six uni-axial legs of the sensor and any preliminary data available will be presented.

3:06PM S20.00006 Synthesis, Structural, and Electrochemical Stability Studies of Nanocrystalline 5V Lithiated Oxides for Asymmetric Supercapacitor, WILLIAM PARKER1, Southern University and A&M College, HUIMING WU, Southern University, RAMBABU BOBBBA2, Southern University and A&M College — For the development of asymmetric (hybrid) supercapacitor, we have synthesized nanoscale double substituted LiNi1−2YCo1−YMn+3+O4 (Y=0.05, 0.1, 0.25 and 0.45) spinels using mechanochemical, hydrothermal, microwave assisted combustion aided procedures. The samples have been characterized by XRD, TEM, and XAFS. Lattice parameter of the spinels increased with nickel content, and decreased from 400 to 600˚C, at which temperature the particle size is ≈ 20nm. The sample with composition LiNi0.15Co0.15Mn1.45O4 has shown the best electrochemical performance, with redox potential of 4.6V, capacity of 129.6mAHg−1, cyclability of 99.9% per cycle, and remained the capacity up to 1 C rate. The XANES of Mn and M as a function of Y showed that the high voltage (~5 V) in the cathode materials of an Li secondary battery is due to the oxidation of M3+ to M4+ (M=Co) and M4+ to M5+ (in the case of M=Ni). The EXAFS analysis revealed that Ni2+ is oxidized to Ni4+ via the Ni3+ state with a Jahn–Teller distorted Ni3+O octahedron. A hybrid device employing nanostructured LiNi1−2YCo1−YMn+3+O4 /polymer electrolyte/nanoporous carbon black (NCB) powders was assembled. grant #: W911NF-07-1-0426

1UG Physics
2Faculty Advisor


Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade F
2:25PM 15HE.00001 Blast waves in atomic cluster media using intense laser pulses. ROLAND SMITH, Imperial College, London — We report on the progress of experimental and numerical investigations of the dynamics of strong (>Mach 50) blast waves driven by focusing sub-ps laser pulses into an extended medium of atomic clusters. A gas of atomic clusters is an extraordinarily efficient absorber of intense laser light and can be used to create high energy density plasmas with tabletop laser systems. These LED plasmas can launch shocks and strongly radiative blast waves with dimensionless parameters scalable to astrophysical objects such as supernova remnants, and have been used by us in a number of shock-evolution and collision studies. To date such experiments have been conducted with modern lasers of <1 J. In order to study processes such as the Vishniac overstability and cooling instability in these systems significantly more input energy may be required due to the weak variation of blast wave velocity with deposited energy \(V_b \propto E^{1/4}\). We report on the scaling of cluster blast wave experiments to laser energies up 0.5kJ using the Vulcan laser at RAL. An extensive suite of diagnostics including multi-frame optical probe systems, streaked Schlieren imaging and keV imaging and spectroscopy was fielded in order to study the growth of spatial and temporal instabilities. To better match astrophysical scenarios with strong radiative pre-hear of material upstream of the shock an additional radiation field was also introduced using a secondary laser heated gold foil target and grazing incidence XUV guiding structure. This allowed us to compare blast wave propagation into cold versus hot ionized upstream gases. These experimental systems provide a useful test bed against which to benchmark numerical simulations, and have been compared to the 3D magnetoresistive hydrocode GORGON and radiation-hydrodynamics code NYM.

2:50PM 15HE.00002 Creating high energy density matter with intense laser driven proton beams1, PRAVESH PATEL, Lawrence Livermore National Laboratory — The interaction of a high-intensity short-pulse laser with a thin foil target can produce an intense highly directional beam of protons. The laser pulse produces a population of suprathermal electrons, which flood the target and set up an electrostatic sheath field at the rear surface. This highly transient field accelerates ions (predominantly protons) from a thin layer at the rear surface to multi-MeV energies on a timescale of just a few hundred femtoseconds. The properties of this proton beam make it an interesting candidate for application to the creation of high energy density matter. We describe experiments conducted on the 350J Titan Petawatt laser at the Lawrence Livermore National Laboratory and on the 500J Vulcan Petawatt laser at the Rutherford Appleton Laboratory to investigate the utility of laser driven proton beams for creating plasma conditions ranging from the warm dense matter regime of a few eV temperature at solid density, to the highly localized multi-keV hot spot temperatures necessary for proton fast ignition.

3:15PM 15HE.00003 Applications of the wave-kinetic approach: from wakefield accelerators to space plasmas1, RAOUl TRINES, STFC Rutherford Appleton Laboratory — The theory of wave-kinetics is a new approach to the study of the propagation of broadband, incoherent waves in dispersive media. The wave-kinetic approach is centered around the propagation of individual wave modes, and both monochromatic and incoherent waves can be described easily through the wave mode distribution function. Where the classical approach to wave-driven processes restricts itself mainly to monochromatic waves coupling to other monochromatic waves, the wave-kinetic approach allows one to study the coupling of random and/or broadband pump waves coupling to monochromatic or coherent structures in the medium. The list of phenomena that can be studied through this approach is very long, reaching from laser-wakefield studies to lower-hybrid drift wave studies, turbulence in planetary atmospheres, and even neutrino-driven shock waves in collapsing stars. We have employed the wave-kinetic approach to study photon acceleration (changing the frequency of laser light using a spatially and temporally changing index of refraction) in ultrafast, ultra-intense laser-plasma interaction experiments. Photon acceleration can be used both as a means to prove the existence of laser-driven wakefields and as a tool to determine their properties. In addition, we have used the wave-kinetic approach to model drift wave turbulence interacting with zonal flows in a magnetized plasma. We have discovered a mechanism for spontaneous generation of soliton-like structures, which has applications ranging from turbulence at the magnetopause boundary layer to edge localized modes in tokamaks. For both laser-plasma interaction and drift mode turbulence, we will compare wave-kinetic simulations against the results of recent experiments.

3:40PM 15HE.00004 BREAK

4:00PM 15HE.00005 Weibel instability in colliding electron-positron-ion plasmas, LUIS SILVA, GolP/Instituto de Plasmas e Fusao Nuclear, Instituto Superior Tecnico, 1049-001 Lisboa, Portugal — The new regimes accessed in ultra intense laser plasma interactions and recent developments in relativistic astrophysics are giving rise to an increased interest in the Weibel instability. In fact, whenever colliding streams of plasmas (arbitrary mixtures of electrons-positrons-ions) are present, a fraction of the kinetic energy of the plasma flows can be converted to a sub-equilibrium magnetic field. In this talk, and using a combination of particle-in-cell simulations and relativistic kinetic theory, I will first describe the recent theoretical advances in our understanding of the Weibel instability and the connection with the electromagnetic beam plasma instability. Emphasis will be given to the coupling with longitudinal modes, leading to the formation of tilted filaments, and to the effects of the collisions and the merging of the Weibel instability with the resistive filamentation instability. In light of these results, the relevance of Weibel instability to ultra intense laser matter interactions (e.g. fast ignition) and to astrophysical scenarios (e.g. in gamma ray bursters and for cluster magnetic fields) will be discussed. Finally, the role of the Weibel instability in the formation of relativistic shocks and in particle acceleration in these structures will also be addressed.

4:25PM 15HE.00006 Energy transport and isochoric heating of ultra-intense laser irradiated target1, YASUHIKO SENTOKU, University of Nevada, Reno — Irradiation of matter with ultra-intense short laser pulses generates MeV electrons and can create plasmas at solid density and temperatures of several hundred eV, i.e. several million degrees. Since hydrodynamic expansion of such micrometer-sized targets, driven apart by the Gigabar pressure of MeV hot electrons, limits their lifetime to a few picoseconds, energy must be deposited rapidly, i.e. on a sub-ps time scale, and deep in the target. Therefore, to realize various applications such as a compact neutron source, blight x-ray, and a good test bed of the high energy density physics, it is essential to understand the energy transport inside dense plasmas. We study ultra-fast heating of thin plastic foils by intense laser irradiation theoretically using collisional two-dimensional particle-in-cell simulations. We find that the laser-generated hot electrons are confined laterally by self-generated magnetic fields, heating the laser focal area beyond keV electron temperatures isochorically in a few picoseconds. Also strong surface magnetic fields are excited due to rapid lateral diffusion of MeV electrons. Using this confinement by the self-generated fields one can excite shock waves that compress the plasma beyond solid density and achieve keV thermal plasmas before the plasma disassembles. Such shocks can be launched at material interfaces inside the target where jumps in the average ionization state and thus electron density lead to Gigabar pressure. They propagate stably over picoseconds accompanied by multi-MegaGauss magnetic fields, and thus have a potential for various applications in high energy density physics.

1This work was supported by UNR under DOE/NNSA grant DE-FG52-01NY14050 and DOE/OFES DE-FG02-05ER54837.
4:50PM 15HE.00007 Transport of high intensity laser-generated hot electrons in cone coupled wire targets1, FARHAT BEG, University of California, San Diego — In this talk, we present results from a series of experiments where cone-wire targets were employed both to assess hot electron coupling efficiency, and to reveal the source temperature of the hot electrons. Experiments were performed on the petawatt laser at the Rutherford Appleton Laboratory. A 500J, 1ps laser (I = 4 x 10^20 W/cm^-2) was focused by an f/3 off-axis parabolic mirror into hollow aluminum cones joined at their tip to Cu wires of diameters from 10 to 40 µm. The three main diagnostics fielded were a copper Kα Bragg crystal imager, a single hit CCD camera spectrometer and a Highly Oriented Pyrolytic Graphite (HOPG) spectrometer. The resulting data were cross-calibrated to obtain the absolute Kα yield. Comparison of the axially diminishing absolute Cu Kα intensity with modeling shows that the penetration of the hot electrons is consistent with one dimensional ohmic potential limited transport (1/e length ∼ 20 µm). The laser coupling efficiency to electron energy within the wire is shown to be proportional to the cross sectional area of the wire, reaching 15% for 40 µm wires. We find that the hot electron temperature within the wire was <750 keV, significantly lower than that predicted by the ponderomotive scaling. A comparison of the experimental results with 2D hybrid PIC simulations using e-PLAS code will be presented and relevance to Fast Ignition will be discussed at the meeting.

1This work performed under the auspices of the U.S. Department of energy under contracts, DE-FG02-05ER55484, W-7405-Eng-48 and DE-FC02-04ER54789 (Fusion Science Center). JK and TM are funded through LLNL’s Institute of Laser Science and Applications grant.

2:00PM - Session S1 APS: Poster Session III (2:00-5:00pm) Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Fourth Floor Lobby

S1.00001 COMPUTATIONAL PHYSICS EDUCATION POSTERS –

S1.00002 Computational Physics Education at Eastern Illinois University: Undergraduate Curriculum and Research, JIE ZOU, Eastern Illinois University — We have recently developed a new B.S. in Physics: Computational Physics Option which offers a balanced curriculum in theoretical and experimental physics and an exposure to the computational approach in physics and engineering. Two new computational courses, “Computational Methods in Physics and Engineering” and “Computational Physics”. Undergraduate research with an emphasis on computation is also an integral part of this curriculum. One research area that we have introduced to our students is the computational modeling and simulation of nanoscale materials. An example is a project that involved phonon dispersion in nanoscale heterostructures, which students obtained by solving the lattice wave equation using the Finite-Difference method. An ongoing undergraduate project involves applying Molecular Dynamics Simulation to the study of the random motion and kinetic theory of gases. In this paper, we present details on our Computational Physics curriculum and the above computational projects. We also analyze the educational benefits that the Computational Physics curriculum and research projects bring to our students.

S1.00003 Coupled pressure and velocity distributions in a pressure-driven flow inside a long pipe with fluid injection through porous walls, ALEXANDER L. FRENKEL, UA, LEONID BOLSHINSKIY, UAH — We are studying steady flows of Newtonian liquids in pipes with porous walls. One end of the pipe is closed; the ambient liquid is injected through the pipe wall under the Darcy-Weisbach law and exits at the open end with a pressure that is kept below the uniform fluid pressure outside the pipe walls. The inside pressure varies with the axial coordinate and is coupled with the varying axial velocity averaged over the cross-section of the pipe. For a long pipe, the Karman-Polhausen averaging of Navier-Stokes equations is used for both laminar and turbulent flow regimes. We obtain a boundary value problem for a nonlinear second-order differential equation governing the velocity distribution and explore numerous flow regimes by numerically solving it. Hence, the pipe pressure is found as a quadratic expression in terms of the velocity derivative. At sufficiently high Reynolds numbers, quite unlike the standard pipe flow with uniform velocity, even the turbulent friction turns out negligible in comparison with the pressure gradient required for accelerating the liquid toward the exit. The inertial approximation allows for an analytic solution. The nonzero-gravity generalization is obtained, and applications to channels with fine-mesh screen walls utilized for the delivery of liquid propellant to the engine at low gravity, are discussed.

S1.00004 Band structure of photons in layered DPS/DNG materials, JOSEPH SHAHB AZIAN, UML, ARAM KARAKASHIAN — In this project the main goal is to study the band gaps of a one dimensional photonic crystal composed of alternating layers of DNG and DPS materials. The material’s optical parameters (electric permittivity and magnetic permeability) are complex and frequency dependent to account for both dispersion and absorption. Here we present the non-Bragg band gaps in a one dimensional photonic crystal composed of alternating layers of DNG and DPS materials. Our center of attention is the study of the zero permittivity, zero permeability and zero average refractive index gaps and the transmission and reflection of photons.

S1.00005 The time-dependent, electromagnetic Aharonov-Bohm effect, ZACHARY KERTZMAN, ATHANASIOS PETRIS, Drake University — Numerical, time-dependent solutions to the relativistic Dirac equation coupled with an external electromagnetic field are obtained using the staggered leap-frog method on a spatial lattice in two dimensions. The numerical stability of the method is evaluated and ensured by appropriate choices of the lattice constant and the time step. The action of the magnetic or electrostatic potentials in the region of zero electromagnetic fields is evaluated by means of the produced diffraction patterns. The time-dependent interference as the spinor is guided around a quantum ring centered about an infinitely-long solenoid magnet is also studied.

S1.00006 Entanglement of Atoms with Vacuum in Jaynes Cummings Model, SAMINA MASOOD, Univ. of Houston Clear Lake, ALLEN MILLER, Syracuse University — We investigate the conditions for entanglement in a system of two atoms and two photon modes with a vacuum, using the Jaynes-Cummings model in the rotating-wave approximation. The results of previous studies are generalized to the case of non-resonant conditions. It is found that the strength of entanglement in atoms is a periodic function of time, in general. We explicitly show that our results are in agreement with existing results and reproduce the existing entanglement conditions under appropriate limits.

S1.00007 Glucose and Aging, JOHN T.A. ELY, University of Washington — When a human’s enzymes attack glucose to proteins they do so at specific sites on a specific molecule for a specific purpose that also can include ascorbic acid (AA) at a high level such as 1 gram per hour during exposure. In an AA synthesizing animal the manifold increase of AA produced in response to illness is automatic. In contrast, the human non-enzymatic process adds a glucose polymerization in collagen and other structural proteins. As Cerami clarified decades ago, extensive crosslinking of proteins contributes to loss of elasticity in aging tissues. Ascorbic acid reduces the random non-enzymatic glycation of proteins. Moreover, AA is a cofactor for hydroxylase enzymes that are necessary for the production and replacement of collagen and other structural proteins. We will discuss the relevance of “aging is scurvy” to the biochemistry of human aging.

S1.00008 ASTROPHYSICS POSTERS –
S1.00009 The Laws of Parallelism, Convergence and Divergence Applied to Some Astrophysical Phenomena
STEWARD BREKKE, Chicago Public Schools (retired) — The gravitational accelerations of various heavenly bodies can illustrate the concept of parallelism by plotting them over time forming straight lines. \( g(\text{earth}) = 9.8 \text{m/s}^2 \), \( g(\text{moon}) = 1.6 \text{m/s}^2 \), and \( g(\text{mars}) = 3.7 \text{m/s}^2 \). The distance between the lines \( g(\text{earth}) \) and \( g(\text{mars}) \) is 6.4m/s\(^2\) and the distance between the lines \( g(\text{earth}) \) and \( g(\text{moon}) \) is 8.2m/s\(^2\). Thus, the greater parallelism (similarity) is between \( g(\text{earth}) \) and \( g(\text{mars}) \) since the distance between the lines is smaller than between \( g(\text{earth}) \) and \( g(\text{moon}) \). The Law of Convergence states that the smaller the angle between two curves, the greater the convergence. The Law of Divergence states that the greater the angle between two curves, the greater the divergence. In the evolution of post-mainsequence stars the evolutionary Hayashi track makes and angle of about 115 for a 1M star, about 132 for a 5M star and for a 10M star 120. Therefore, the divergence of a 5M star is greater than for a 5M or 10M star or greater dissimilarity from the main sequence track kstars. The angles of convergence of Hayashi tracks for stars approaching the main sequence is about 155 for a 4M, 160 for a 2M or 56 for a 0.1M star indicating that the Hayashi track for a 0.1M star is more similar to the main sequence stars. In nucleosynthesis of elements the angle of divergence is approx. 11.35 degrees between the curve for light nuclei and heavier nuclei in the proton-neutron curves. In this manner convergence, divergence and parallelism can be quantified for phenomena.

1 previous papers presented at various APS meetings

S1.00010 Pioneer Anomaly: Artifact or Real Astrophysical Phenomenon of the Solar System.
, JACQUES LEIBOVITZ — A crucial experiment is suggested to determine conclusively whether the Pioneer anomaly (PA) is an artifact or a real astrophysical phenomenon of the Solar System (APSS). NASA may already have in its archives the data needed. An experimental proof that the PA is an artifact would end speculations on possible new physics to explain the PA. If the experiment proves that the PA is an APSS, then a second crucial experiment is suggested to determine conclusively whether the (then proven) APSS is, or is not, produced by dark matter (DM). NASA may already have in its archives the data needed. If the answer is: “Not DM,” then physicists would search for a suitable new physics to explain the PA. However, if the answer is DM, then it would be necessary to reconcile the amount of DM, needed in the Solar System to explain the PA, with the ranging results used by NASA to fix the locations of the planets. That might require a new physics, but in a different direction. Either way would improve our understanding of our Solar System.

S1.00011 Multi-Angle Multi-Group Radiation-Hydrodynamics Simulations Of Core-Collapse Supernovae
, CHRISTIAN D. OTT, Steward Observatory, The University of Arizona, ADAM BURROWS, Department of Astrophysical Sciences, Princeton University, LUC DESSART, Department of Astronomy and Steward Observatory, The University of Arizona, ELI LIVNE, Racah Institute of Physics, Hebrew University, Jerusalem. JEREMIAH MURPHY, Department of Astronomy and Steward Observatory, The University of Arizona — We present new results from axisymmetric multi-angle, multi-group neutrino radiation-hydrodynamic calculations of the postbounce phase of rotating and nonrotating core-collapse supernovae. We analyze the effect of the multi-angle treatment on neutrino radiation field anisotropies and the net energy deposition and compare our results in detail with multi-group flux-limited diffusion counterpart calculations.

1 This work was supported by NSF through a Joint Institute for Nuclear Astrophysics Postdoctoral Fellowship and by the DOE through the Office of Science SciDAC Program
2 JINA Postdoctoral Fellow

S1.00012 Cylindrical Harmonic Galaxy Classification
, JEFF RIESS, MICKEY KUTZNER, Andrews University, AN-DREWS UNIVERSITY TEAM — In this study, we investigate the use of features in the Spherical Harmonic power spectra to aid in the classification of galaxies. Let \( I(r, \theta) \) represent a galaxy image function in polar coordinates. The image function may be represented as a two-dimensional Fourier-Bessel series. The coefficients in the expansion, \( A_{n,i} \) and \( B_{n,i} \), multiply the radial Bessel functions of order \( n \), \( J_n(a_0 r / R) \) and the polar functions \( \cos(n \theta) \) and \( \sin(n \theta) \), respectively. The coefficients are known as the Fourier-Bessel Transform (FBT) of \( I(r, \theta) \). The parameter \( \alpha_{n,i} \) is the ith root of the Bessel function of the first kind of order \( n \), \( J_n(x) \), and \( R \) is the radius to the edge of the galaxy image. We have computed the coefficients \( A_{n,i} \) and \( B_{n,i} \) for a number of representative FBT spectra. Spectra are presented as 3D plots of the modulus of \( \alpha_{n,i} \) and \( B_{n,i} \) versus the root number, \( i \), and the order \( n \). Radial structures (such as spiral arms) are manifested in the spectra as peaks in amplitude at certain values of \( i \), whereas, azimuthal variations are seen as amplitude peaks at particular values of \( n \). Since each galaxy type will have a unique spectrum type due to its distinct matter distributions, we investigate the possibility of automatically classifying galaxies by minimizing the Euclidean distance of the galaxy’s FBT spectrum to typical spectra of each morphological type.

1 Andrews University Office of Scholarly Research

S1.00013 Distinguishing Modified Gravity from Dark Energy
, PHILLIP ZUKIN, EDMUND BERTSCHINGER, MIT — The acceleration of the universe can be explained either through dark energy or through the modification of gravity on large scales. In this paper we investigate modified gravity models and compare their observable predictions with dark energy models. Modifications of general relativity are expected to be scale-independent on super-horizon scales and scale-dependent on sub-horizon scales. For scale-independent modifications, utilizing the conservation of the curvature scalar and a parameterized post-Newtonian formulation of cosmological perturbations, we derive results for large scale structure growth, weak gravitational lensing, and cosmic microwave background anisotropy. For scale-dependent modifications, inspired by recent \( f(R) \) theories we introduce a parameterization for the gravitational coupling \( G \) and the post-Newtonian parameter \( \gamma \). These parameterizations provide a convenient formalism for testing general relativity. However, we find that if dark energy is generalized to include both entropy and shear stress perturbations, and the dynamics of dark energy is unknown a priori, then modified gravity cannot in general be distinguished from dark energy using cosmological linear perturbations.

S1.00014 The Advanced Gamma-ray Imaging System (AGIS): A Nanosecond Time Scale Stereoscopic Array Trigger System
, FRANK KRENNRICH, J. BUCKLEY, K. BYRUM, J. DAWSON, G. DRAKE, D. HORAN, H. KRAWCZYNSKI, M. SCHROEDTER, Iowa State University — Imaging atmospheric Cherenkov telescope arrays (VERITAS, HESS) have shown unprecedented background suppression capabilities for reducing cosmic-ray induced air showers, muons and night sky background fluctuations. Next-generation arrays with the order of 100 telescopes offer larger collection areas, provide the possibility to see the air shower from more view points on the ground, have the potential to improve the sensitivity and give additional background suppression. Here we discuss the design of a fast array trigger system that has the potential to perform a real time image analysis allowing substantially improved background rate suppression at the trigger level.
The Advanced Gamma-ray Imaging System (AGIS): Telescope Optical System Designs
Vladimir Vassiliev, UCLA, Jim Buckley, Washington University, Abe Falcone, Pennsylvania State University, Steven Fegan, UCLA, John Finley, Purdue University, Victor Guarino, ANL, David Hanna, McGill University, Philip Kaaaret, University of Iowa, Alex Konoelko, Purdue University, Henri Krawczynski, Washington University, Roger Romani, Stanford University, Trevor Weekes, Harvard-Smithsonian CfA, AGIS Collaboration — AGIS is a conceptual design for a future ground-based gamma-ray observatory based on an array of ~100 imaging atmospheric Cherenkov telescopes (IACTs) with a sensitivity to gamma-rays in the energy range 40 GeV-100 TeV. The anticipated improvement of AGIS sensitivity, angular resolution, and reliability of operation impose demanding technological and cost requirements on the design of the IACTs. In this submission we focus on the optical system (OS) of the AGIS telescopes and consider options which include traditional Davies-Cotton and the other prime-focus telescope designs, as well as a novel two-mirror aplanatic OS originally proposed by Schwarzschild. Emerging new mirror production technologies based on replication processes such as cold and hot glass slumping, cured CFRP, and electroforming provide new opportunities for cost effective solutions for the design of the OS. We evaluate the capabilities of these mirror fabrication methods for the AGIS project.

The Advanced Gamma-ray Imaging System (AGIS): Telescope Mechanical Designs
V. Guarino, J. Buckley, K. Byrum, A. Falcone, S. Fegan, J. Finley, D. Hanna, D. Horan, P. Kaaaret, A. Konoelko, H. Krawczynski, F. Krennrich, R. Wagner, M. Woods, V. Vassiliev, AGIS Collaboration — The concept of a future ground-based gamma-ray observatory, AGIS, in the energy range of 40 GeV-100 TeV is based on ~100 imaging atmospheric Cherenkov telescopes (IACTs). The anticipated improvements of AGIS sensitivity, angular resolution and reliability of operation impose demanding technological and cost requirements on the design of IACTs. The relatively inexpensive Davies-Cotton telescope design has been used in ground-based gamma-ray astronomy for almost fifty years and is an excellent option. We are also exploring alternative designs and in this submission we focus on the recent mechanical design of a two-mirror telescope with a Schwarzschild-Couder (SC) optical system. The mechanical structure provides support points for mirrors and camera. The design was driven by the requirement of minimizing the deflections of the mirror support structures. The structure is also designed to be able to slew in elevation and azimuth at 10 degrees/sec.

Quasar Additional Intrinsic Redshift Mechanism??
C. F. Gallo, Superconix Inc — From observations and spectral peculiarities, Quasars have complex “intrinsic” redshift(s) added to Hubble redshift. Different Quasars have variable surrounding cloud of plasma and gases (atomic and molecular). Variable local redshifting ensues from photon energy-loss interactions with surrounding cloud. Two Quasar anomalies are examined. (1) The H:21cm redshift is small compared to larger redshift of higher energy photons, possibly due to Raman redshift since low energy H:21cm photons have insufficient energy to excite redshifting Raman levels. (2) The hydrogen Balmer lines show an additional redshift (~1000km/s) broadened component, possibly due to Raman hyperfine redshift via hydrogen nuclear spin. This extra H:Balmer-type component is NOT present in CIV and MgII lines which have NO nuclear spin. NOTE: Any Raman energy-loss mechanism will effectively redshift the original line, but effectiveness will decrease as line component, possibly due to Raman hyperfine redshift via hydrogen nuclear spin. This extra H:Balmer-type component is NOT present in CIV and MgII lines which have NO nuclear spin.

S1.00020 Observation of the High-Energy Peaked BL Lac Object 1ES 1218+304 with STACCE
Naureen Akhter, Barnard College, Columbia University, J. Ball, UCLA, Current address: Gemini Observatory, J. E. Carson, UCLA, Current address: SLAC, C. E. Covault, CWRU, D. D. Driscoll, CWRU, Current address: Kent State Univ., P. Fortin, Barnard College, Columbia University, D. M. Gingrich, U. of Alberta & TRIUMF, Canada, D. S. Hanna, McGill Univ., Canada, A. Jarvis, UCLA, J. Kildea, McGill University, Current address: FLWO, T. Lindner, McGill University, Current address: Univ. of British Columbia, Canada, C. Mueller, McGill University, Canada, R. Mukherjee, Barnard College, Columbia University, R. A. Ong, UCLA, K. Ragam, McGill University, Canada, D. A. Williams, Scipp, J. Zweerink, UCLA, STACCE Collaboration — We present the analysis of recent high-energy gamma-ray observations of the BL Lac object 1ES 1218+304 with the Solar Tower Atmospheric Cherenkov Effect Experiment (STACCE). 1ES 1218+304 is an X-ray bright high-energy peaked BL Lac (HBL) that is also a source of TeV gamma rays, and has recently been detected by the atmospheric Cherenkov telescopes MAGIC and VERITAS. We will present results from STACCE observations of 1ES 1218+304 in the 2006 and 2007 observing seasons.

S1.00015 The Advanced Gamma-ray Imaging System (AGIS): Telescope System Designs
Vladimir Vassiliev, UCLA, Jim Buckley, Washington University, Abe Falcone, Pennsylvania State University, Steven Fegan, UCLA, John Finley, Purdue University, Victor Guarino, ANL, David Hanna, McGill University, Philip Kaaaret, University of Iowa, Alex Konoelko, Purdue University, Henri Krawczynski, Washington University, Roger Romani, Stanford University, Trevor Weekes, Harvard-Smithsonian CfA, AGIS Collaboration — AGIS is a conceptual design for a future ground-based gamma-ray observatory based on an array of ~100 imaging atmospheric Cherenkov telescopes (IACTs) with a sensitivity to gamma-rays in the energy range 40 GeV-100 TeV. The anticipated improvement of AGIS sensitivity, angular resolution, and reliability of operation imposes demanding technological and cost requirements on the design of the IACTs. In this submission we focus on the optical system (OS) of the AGIS telescopes and consider options which include traditional Davies-Cotton and the other prime-focus telescope designs, as well as a novel two-mirror aplanatic OS originally proposed by Schwarzschild. Emerging new mirror production technologies based on replication processes such as cold and hot glass slumping, cured CFRP, and electroforming provide new opportunities for cost effective solutions for the design of the OS. We evaluate the capabilities of these mirror fabrication methods for the AGIS project.

S1.00017 The Advanced Gamma-ray Imaging System (AGIS): Telescope Mechanical Designs
V. Guarino, J. Buckley, K. Byrum, A. Falcone, S. Fegan, J. Finley, D. Hanna, D. Horan, P. Kaaaret, A. Konoelko, H. Krawczynski, F. Krennrich, R. Wagner, M. Woods, V. Vassiliev, AGIS Collaboration — The concept of a future ground-based gamma-ray observatory, AGIS, in the energy range of 40 GeV-100 TeV is based on ~100 imaging atmospheric Cherenkov telescopes (IACTs). The anticipated improvements of AGIS sensitivity, angular resolution and reliability of operation impose demanding technological and cost requirements on the design of IACTs. The relatively inexpensive Davies-Cotton telescope design has been used in ground-based gamma-ray astronomy for almost fifty years and is an excellent option. We are also exploring alternative designs and in this submission we focus on the recent mechanical design of a two-mirror telescope with a Schwarzschild-Couder (SC) optical system. The mechanical structure provides support points for mirrors and camera. The design was driven by the requirement of minimizing the deflections of the mirror support structures. The structure is also designed to be able to slew in elevation and azimuth at 10 degrees/sec.

S1.00019 Quasar Additional Intrinsic Redshift Mechanism??
C. F. Gallo, Superconix Inc — From observations and spectral peculiarities, Quasars have complex “intrinsic” redshift(s) added to Hubble redshift. Different Quasars have variable surrounding cloud of plasma and gases (atomic and molecular). Variable local redshifting ensues from photon energy-loss interactions with surrounding cloud. Two Quasar anomalies are examined. (1) The H:21cm redshift is small compared to larger redshift of higher energy photons, possibly due to Raman redshift since low energy H:21cm photons have insufficient energy to excite redshifting Raman levels. (2) The hydrogen Balmer lines show an additional redshift (~1000km/s) broadened component, possibly due to Raman hyperfine redshift via hydrogen nuclear spin. This extra H:Balmer-type component is NOT present in CIV and MgII lines which have NO nuclear spin. NOTE: Any Raman energy-loss mechanism will effectively redshift the original line, but effectiveness will decrease as line component, possibly due to Raman hyperfine redshift via hydrogen nuclear spin. This extra H:Balmer-type component is NOT present in CIV and MgII lines which have NO nuclear spin.

S1.00018 The Advanced Gamma-ray Imaging System (AGIS): Camera Electronics Designs
H. Tajima, J. Buckley, K. Byrum, G. Drake, A. Falcone, S. Funk, J. Holder, D. Horan, H. Krawczynski, R. Ong, S. Swordy, R. Wagner, D. Williams, AGIS Collaboration — AGIS, a next generation of atmospheric Cherenkov telescope arrays, aims to achieve a sensitivity level of a milliCrab for gamma-ray observations in the energy band of 40 GeV to 100 TeV. Such improvement requires cost reduction of individual components with high reliability in order to equip the order of 100 telescopes necessary to achieve the sensitivity goal. We are exploring several design concepts to reduce the cost of camera electronics while improving their performance. These design concepts include systems based on multi-channel waveform sampling ASIC optimized for AGIS, a system based on IIT (image intensifier tube) for large channel (order of 1 million channels) readout as well as a multiplexed FADC system based on the current VERITAS readout design. Here we present trade-off in the studies of these design concepts.

S1.00021 Thermo-Rotational Instability in Plasma Disks Around Compact Objects
Bruno Coppi, M.I.T. — Differentially rotating plasma disks, around compact objects, that are imbedded in a “seed” magnetic field are shown to develop vertically localized ballooning modes that are driven by the combined radial gradient of the rotation frequency and the vertical gradients of the particle density and temperature[1]. When the electron mean free path is shorter than the disk height and the (vertical) thermal conductivity can be neglected, the vertical particle flows produced by the modes have the effect to drive the density and radial temperature profiles toward the “adiabatic condition” where $\eta = \rho (d\theta/dz)/(d\rho/dz) = 2/3$. Here $T$ is the plasma temperature and $n$ the particle density. The faster growth rates correspond to steeper temperature profiles ($\eta > 2/3$) such as those produced by an internal (e.g. viscous) heating process. In the end, ballooning modes excited for various values of $\eta$ can lead to the evolution of the disk into a different current carrying configuration such as a sequence of plasma rings[2].

* Sponsored in part by the U.S. Department of Energy


S1.00022 A High Frequency Search for Gravitational Wave Bursts. BRENNAH HUGHEY, MIT, LIGO SCIENTIFIC COLLABORATION — We present a first look at an all-sky gravitational wave burst search in the frequency range 1 to 6.5 kHz using LIGO data. Previous burst searches with ground-based interferometers have been limited to frequencies below 2 kHz. However, various models predict gravitational wave emission in the several kiloHertz range from astrophysical phenomena including gravitational collapse, neutron star modes and low mass black hole mergers. This shot-noise dominated frequency regime can be analyzed with the same tools as lower frequency analyses.

S1.00023 Reheating of the universe after inflation with f(\phi)R gravity. YUKI WATANABE, EIICHIRO KOMATSU, Univ. of Texas, Austin — We show that reheating of the universe occurs spontaneously in a broad class of inflation models with f(\phi)R gravity (\phi is inflaton). The model does not require explicit couplings between \phi and bosonic or fermionic matter fields. The couplings arise spontaneously when \phi settles in the vacuum expectation value (vev) and oscillates, with coupling constants given by derivatives of f(\phi) at the vev and the mass of resulting bosonic or fermionic fields. This mechanism allows inflaton quanta to decay into any fields which are not conformally invariant in f(\phi)R gravity theories.

1This work is supported by Alfred P. Sloan Foundation.

S1.00024 Projectile acceleration to a velocity over the Earth’s escape velocity and application in planetary science. T. KADONO, K. SHIGEMORI, S. FUJIOKA, K. OTANI, T. SANO, A. SHIROSHTA, Y. HIRONAKA, Y. SAKAWA, ILE, Osaka university, N. OZAKI, T. KIMURA, K. MIYANISHI, T. ENDO, Graduate School of Engineering, Osaka university, M. ARAKAWA, Nagoya University, A. NAKAMURA, Kobe University, S. SUGITA, T. MATSUI, University of Tokyo — Impact velocity of meteorites on Earth at the final stage of planetary accretion becomes more than 10 km/s. However, macroscopic (larger than 0.1 mm) projectiles are not easily accelerated to more than 10 km/s by two-stage light-gas guns. One possible method to a velocity larger than 10 km/s is the irradiation of high-intensity lasers. Here, we describe the first results of projectile (glass spheres) acceleration experiments to a velocity higher than 10 km/s using GEKKO XII laser at Institute of Laser Engineering. Glass spheres are accelerated to a velocity of 15 km/s. This is enough to simulate hypervelocity impacts on the surface of the proto-planets and investigate various phenomena caused by the impacts such as impact vaporization of silicate rocks, crater formation on rocks, and metamorphism due to high pressure.

S1.00025 Limits on Relativistic Magnetic Monopole Flux from RICE. DANIEL HOGAN, University of Kansas, RICE COLLABORATION — The Radio Ice Cherenkov Experiment (RICE) is a radio antenna array at the South Pole. A Monte Carlo simulation of magnetic monopole propagation through polar ice is used to determine RICE’s cross-section for monopole detection. We present final results for ultrarelativistic (\gamma \geq 10^7) magnetic monopole flux upper bounds based on RICE observations from 2001 through 2005. This limit is the strongest direct measurement of ultrarelativistic monopole flux.

S1.00026 The Advanced Gamma-ray Imaging System (AGIS): Focal Plane Detectors. RESHMI MUKHERJEE, Barnard College, Columbia University, K. BYRUM, G. DRAKE, Argonne, A. FALCONE, Penn State, S. FUNK, SLAC, D. HORAN, Argonne, H. TAJIMA, SLAC, B. WAGNER, Argonne, D. WILLIAMS, UC Santa Cruz, AGIS COLLABORATION, FOCAL PLANE INSTRUMENTATION WORKING GROUP COLLABORATION — Report of the Focal Plane Instrumentation Working Group, AGIS collaboration: The Advanced Gamma-ray Imaging System (AGIS) is a concept for the next generation instrument in ground-based very high energy gamma-ray astronomy. It has the goal of achieving significant improvement in sensitivity over current experiments. One of the main requirements for AGIS will be to achieve higher angular resolution than current imaging atmospheric Cherenkov telescopes (IACTs). Simulations show that a substantial improvement in angular resolution may be achieved if the pixel size is reduced to 0.05 deg, below that of current IACTs. Reducing the cost per channel and improving reliability and modularity are other important considerations. Here we present several alternatives being considered for AGIS, including both silicon photomultipliers (SiPMs) and multi-anode photomultipliers (MAPMTs) and summarize results from feasibility testing by various AGIS photodetector group members.

S1.00027 CZT Detector Development for Hard X-ray Astronomy. A.B. GARSON III, Washington University in St. Louis, Q. LI, M. BEILICKE, R. BOSE, A. BURGER, P. DOWKONNT, M. GROZA, G. SIMBURGER, H. KRAWCZYNSKI — Cadmium Zinc Telluride (CZT) has proven itself as an excellent material for detection of hard X-rays. Advances in crystal growth have increased the quality and size of available single CZT crystals. We report on our ongoing development and characterization of CZT detector systems. With our dedicated class-100 cleanroom, we fabricate detectors using CZT crystals from different manufacturers. Using photolithography and e-beam evaporation, we can produce detectors with different contact designs (pixelated, strip, monolithic, steering grid), contact dimensions (down to 50 microns), and contact materials (In, Ti, Au, etc.). In addition, we develop ASIC readouts for various CZT detector applications, including our characterization of the detectors. We measure I-V and C-V curves for the detectors as well as their spectroscopic performance. We compare measured results with those from detailed modelling and simulations. The CZT detector systems can then be optimized for applications such as X-ray imaging and polarimetry with satellite or balloon-borne instruments.

S1.00028 Eight and a half minutes. GABRIELE VARIESCHI, Loyola Marymount University — An interesting conceptual question, regarding the actual position of the Sun at sunset or sunrise, is analyzed and discussed in terms of fixed vs. rotating frames of reference. A simple, educational experiment can be easily set up to demonstrate this effect and introduce topics such as rotating systems, apparent motion and the Coriolis effect.

2This research was supported by an award from Research Corporation.

S1.00029 Searching for gravitational wave fingerprints of SGR QPOs. RUBAB KHAN — Soft Gamma Repeaters are young neutron stars or supernova remnants with very strong magnetic fields that irregularly emit X-ray and gamma-ray bursts, and occasionally produce huge burst fluxes. Quasi periodic oscillations (QPOs) in the X-ray tail of such flares have been observed during the August 1998 giant flare from SGR 1900+14 and the Dec 2004 giant flare from SGR 1806-20. These QPOs can plausibly be accompanied by gravitational wave emission up to the energy scale of the electromagnetic emission. The search algorithm used for the analysis relies on coincident data streams from multiple interferometric gravitational wave detectors and incorporates the temporal and directional information available from detected SGR flares.

S1.00030 ABSTRACT WITHDRAWN

S1.00031 Active seismic isolation systems for Enhanced and Advanced LIGO. JEFFREY KISSEL, Louisiana State University — In order to mitigate the dominant low-frequency noise source for the next generation of interferometric gravitational wave detectors, several new systems are in development that will actively isolate optics and readout sensors from ground motion. For enhanced LIGO the output mode cleaner and photodiode readouts are to be positioned on a single-stage active isolation platform which will reduce ground motion by at least a factor of 50 at 1 Hz. Advanced LIGO will include several single-stage isolation platforms and the core optics will be suspended from two-stage platforms which will suppress ground motion by a factor of 3000 at 10 Hz. We present first results from the single-stage isolation platforms now installed at the observatories and comparisons between expected and observed isolation performance.
S1.00032 ACCELERATORS AND STORAGE RINGS POSTERS –

S1.00034 Multi-bunch Plasma Wakefield Accelerator Experiments at the BNL AT1, PATRIC MUGGLI, THEMOS KALLOS, TOM KATSOULEAS, USC, VITALY YAKIMENKO, MARCUS BABZIEN, KARL KUSCHE, IGOR POGORELSKY, BNL, WAYNE KIMURA, STI Optronics — We present initial results obtained with a plasma wakefield accelerator driven by a train of microbunches. The microbunch train is produced with a masking technique [P. Muggli et al., this conference]. The plasma is produced in a cm-long gas-filled capillary discharge. The plasma density is measured using Stark broadening of the hydrogen H-alpha line. It is adjusted such that the plasma wavelength is equal to the microbunches spacing. In this case the train resonantly drives the wake, and the accelerating field behind the train with a variable number of microbunches is maximized. The energy loss of each microbunch increases with the microbunch number and depends on the charge in each microbunch. The accelerating wake field is sampled by a witness bunch following the drive train. This multi-bunch method could be used to multiply the energy of a future linear particle collider with a high efficiency. The experimental set-up, as well as detailed experimental results will be presented.

1 This work is supported by the US Department of Energy

S1.00035 Fast Ion Generation by Short High Intensity Laser Pulses, GALINA DUDNIKOVA, UMD College Park, VALERY BYCHENKOV, Lebedev Institute Physics RAS, Moscow — Developments in laser technology have enabled high power lasers to produce multi-terawatt pico-second and femto-second pulses which allow to examine the fundamental physics of high intensity, \( I > 10^{18} \text{ W/cm}^2 \), laser-produced plasmas and have many potential applications: compact neutron source, new methods in nuclear medicine, isotope and relativistic ion beam production. On the base of 2D PIC simulation ion generation from an overdense plasma foil illuminated by the laser pulse with variable intensity and FWHM duration has been studied. Formation of quasi-monoenergetic ion beam takes place with thin homogeneous foils with light and heavy ions. The conditions of optimal ion acceleration in terms of the intensity and pulse duration are carried out.

S1.00036 MaRIE: Matter-Radiation Interactions in Extremes, a Signature Facility Providing Experimental Resources for Transformational Materials Discovery, CRIS W. BARNES, R.D. FULTON, DAVID J. FUNK, CARTER P. MUNSON, JOHN L. SARRAO, KURT F. SCHOENBERG, Los Alamos National Laboratory — Materials-centric national security science is vital for addressing 21st Century missions of energy security, stockpile stewardship, homeland security, and providing discovery science. Relevant grand challenges of the next two decades include: closing the 10 TW gap between the energy we have and the energy we need; transforming the enterprise of the nuclear weapons complex; and detecting threats with unprecedented sensitivity and efficiency. MaRIE is a proposed signature facility for Los Alamos National Laboratory that is centered on creating and exploiting radiation-matter interactions and providing transformational materials performance through validated predictive multi-scale understanding. Building on the capabilities of the Los Alamos Neutron Science Center, components of MaRIE will provide extreme irradiation fluxes, multiple diagnostic probes to bridge the ‘micron gap’ between atomic scale/molecular dynamics and continuum model/integrated tests, and synthesis and characterization labs to make, measure, and model materials. This presentation will describe the challenges, approaches, and implementation timescale being developed for MaRIE, and engender input and interest by the scientific user community.

S1.00037 GRAVITATION POSTERS –

S1.00038 A new torsion balance for direct tests of the Universality of Free Fall, KASEY WAGONER, Washington University in St. Louis, AMIT SIRCAR, Institute for Plasma Research, Gandhinagar India, RAMANATH COWSIK, Washington University in St. Louis — The principle of equivalence between passive gravitational and inertial mass is a corner stone of General Relativity(GR) and thus is of great interest to anyone wishing compare GR to alternative gravitational theories. We present a new instrument, in the form of a highly sensitive torsion balance, for a direct test of this equivalence. The balance which has a natural frequency of \( \Omega_0 \sim 1.6 \times 10^{-4}\text{Hz} \) is viewed by an autocollimating optical lever with large dynamic range and high resolution. Based on the design of this balance we should be able to probe the universality of free fall more sensitively then the earlier experiments with about one year of data acquisition. Design and construction of all of the pieces comprising the balance are finished and final assembly is in progress. In addition to design aspects we report on the progress towards a complete instrument.

S1.00039 High Resolution Black Hole Simulations, PAUL WALTER, RICHARD MATZNER, University of Texas at Austin, JON ALLEN, University of Texas at Austin, ANDREA NEROZZI, University of Jena, MATT ANDERSON, Brigham Young University — Developed at the University of Texas, openGR is an open framework for numerical simulations. We discuss results of high resolution binary black hole merger simulations and the resulting gravitational radiation. Fixed Mesh Refinement (FMR) simulations using openGR were carried out on Ranger, the new supercomputer at TACC (Texas Advanced Computing Center). Convergence results are also discussed.

S1.00040 Black hole motion as a quantum object or as a classical object, CAROLINE HERZENBERG — Results of a recent study of transition between quantum and classical behavior are now applied to black holes. The study, based on modification of quantum behavior in a cosmological context, predicts the existence of an uncertainty in spatial position dependent upon the mass of an object, and leads to a criterion separating quantum from classical behavior. Specifying that such an uncertainty in position be smaller than the size of the object defines a critical size that appears to provide a fundamental limit distinguishing the realm of objects governed by classical laws from those governed by quantum mechanics. A new application of this criterion to black holes indicates that the motion of small black holes would be characteristically quantum mechanical, while the motion of large black holes would be classical, with the threshold distinguishing these behaviors at a Schwarzschild radius of roughly the size of a nucleon.
S1.00041 Exact Solution for a Gravitational Wave Detector, DMITRI RABOUNSKI, LARISSA BORISSOVA, Moscow, Russia — The experimental statement on gravitational waves proceeds from the equation for deviating geodesic lines and the equation for deviating non-geodesics. Weber’s result was not based upon an exact solution to the equations, but on an approximate analysis of what could be expected: he expected that a plane weak wave of the space metric may displace two resting particles with respect to each other. In this work, exact solutions are presented for the deviation equation of both free and spring-connected particles. The solutions show that a gravitational wave may displace particles in a two-particle system only if they are in motion with respect to each other or the local space (there is no effect if they are at rest). Thus, gravitational waves produce a parametric effect on a two-particle system. According to the solutions, an altered detector construction can be proposed such that it might interact with gravitational waves: 1) a horizontally suspended cylindrical pig, whose butt-ends have basic relative oscillations induced by a laboratory source; 2) a free-mass detector where suspended mirrors have laboratory-induced basic oscillations relative to each other.

S1.00042 The RIDGE pipeline as a method to search for gravitational waves associated with magnetar bursts, JASON LEE, Andrews University, SHANTANU DESAI, Penn State University, KAZUHIRO HAYAMA, SOUMYA MOHANTY, University of Texas, Brownsville, MALIK RAKHMANOV, Southeastern Louisiana University, TIFFANY SUMMERSCALES, Andrews University — RIDGE is a data analysis pipeline which implements a regularized, coherent approach to search for short-duration gravitational wave signals in the data from a network of gravitational wave detectors. We discuss the RIDGE pipeline and describe its potential in the search for gravitational waves associated with soft gamma repeaters (SGRs) and anomalous X-ray pulsars (AXPs). SGRs and AXPs are thought to be the result of seismic events in the crust of a magnetar (a neutron star with a strong magnetic field) which should produce short bursts of gravitational waves.

S1.00043 The Cavendish Experiment, General Relativity, Nuclear Quantum Gravitation, RONALD R. KOTAS, Grand Quantum Research — The Cavendish Experiment - Demonstration clearly shows the Gravitational attraction between two masses, which is a force proportional to the product of the masses and the inverse of the distance between them. General Relativity fails the Cavendish Experiment because there is no force between two gravitating masses but instead pictures a fallacious time-space concept. GR has no definitive proofs. The very hot corona and not GR cause the bending of light near and about the Sun The Perihelion of Mercury, the 43 arc seconds is $3.8 \times 10^{-12}$ of the total and is not a proof of GR. This Perihelion rotation is nothing more than another mode of Newtonian mechanics explained by Newtonian mechanics. Each orbit is an ellipse, a Newtonian function that adds together because of Newtonian functions and accounts for any movement and advancement of Mercury. Because of gravity and speed changes, clocks change, time does not change. Other proofs are not valid because they are Quantum effects or plainly Newtonian refractions. Nuclear Quantum Gravitation clearly explains the gravitational force between two gravitating masses because of alternating electromagnetic functions in nuclei of matter. Some 20 proofs and indications prove this, plainly and clearly. Any gravity theory that does not conform to the Cavendish demonstration is not a viable theory of gravity. With Nuclear Quantum Gravitation, the Forces are plainly and coherently unified.

S1.00044 Einstein’s Math Errors Profoundly Affect Mathematical and Physical Theory, DAVID PRESSLER, Primary Nuclear Research — Einstein treats time as a vector, however, time has no direction associated with it; it is a scalar, it only has magnitude and is specified completely by giving it a number or units. Vectors possess both magnitude and direction. To mathematically equate time with direction is ambiguous and commits a Fallacy of Ambiguity. It is physically impossible to have space with more than three directions. Any theory where time is represented as a forth direction does not represent reality, i.e., $(x, y, z, t)$. Einstein defines the speed of light as a constant, in the equation $c = d$ (distance)/$t$ (time). In this direct proportion Einstein changes the time factor (denominator), when time slows down due to motion but he does not change the distance factor (numerator). This is an error. In reality, time slows down when space contracts in all three directions, in the system of Cartesian coordinates $(x, y, z)$, or C-Space. Pressler’s Law of C-Space: The speed of light will always be measured as a constant, $c$, in all three directions, in ones own inertial reference frame and the speed of light will always be measured to be different in all other inertial reference frames which are at a different gravity or kinetic energy level. Time is exactly defined as the rate of physical process; how fast things take place. This new paradigm shift redefines the Michelson-Morley where both mirrors move inward toward the center of the interferometer.

S1.00045 UNDERGRADUATE RESEARCH POSTERS —

S1.00046 Limits on Expansion of Local Planetary Nebula using CCD Imaging, ROBERT ARN, CASEY WATSON, DANIEL MILLER, Millikin University — Over the past decade, the growing availability of CCD (Charged Couple Device) chips has provided opportunities for smaller observatories that previously existed only for the world’s largest astronomical facilities. By using two SBIG CCD cameras, the ST-7 and STL-1001E, we were able to successfully image several, local planetary nebulae. Based on the data we collected and a simple model for the radiation pressure driven growth of the nebulae, we were able to place limits on their ages, mass-loss rates, and outflow velocities that are in excellent agreement with previous findings.

S1.00047 Quantification of atmospheric seeing conditions while conducting observations in Ursa Major, JOSHUA CLIFFORD, BRITTANY JACKSON, ADAM JONES, Graves County High School — Researchers from Telescopes in Education and Research at Murray State (TERMS) recently developed indices to quantify astronomical seeing conditions. The required images were converted from a consumer grade VHS-C camcorder video by USB powered TV tuner into an uncompressed AVI format and imported into ImageJ for analysis. The first analysis was for HIP 26241, also known as Iota Orionis. We reproduce the technique for a different region of the sky around HIP 65378, also known as Mizar, at a different time of year from the same urban environment. For the star in question, we determine the photometric index and measure the horizontal and vertical deviation equation of both free and spring-connected particles. The solutions show that a gravitational wave may displace particles in a two-particle system only if they are in motion with respect to each other or the local space (there is no effect if they are at rest). Thus, gravitational waves produce a parametric effect on a two-particle system. According to the solutions, an altered detector construction can be proposed such that it might interact with gravitational waves: 1) a horizontally suspended cylindrical pig, whose butt-ends have basic relative oscillations induced by a laboratory source; 2) a free-mass detector where suspended mirrors have laboratory-induced basic oscillations relative to each other.

1We wish to thank Arthur Pallone of Murray State University for providing the project idea and Velvet Dowdy of Graves County High School for her guidance.

S1.00048 Resolving the Higgs, DOUG SCHAFFER, CDF, CDF COLLABORATION — At CDF, one of the main search strategies for the Higgs boson uses the WH production mode. In this channel, the W boson decays into a lepton (either electron or muon) and neutrino while the Higgs boson (H) decays into a bottom quark and an anti-bottom quark pair. The charged leptons can be accurately detected and measured, while the neutrino and the quarks are measured relatively poorly. This analysis attempts to estimate the neutrino transverse energy, and then use this information to in turn correct the measurement of the quark energies. This method may allow a much more accurate determination of the Higgs boson mass in WH events. We present expected improvements in Higgs mass resolution.

1We wish to thank Arthur Pallone of Murray State University for providing the project idea and Velvet Dowdy of Graves County High School for her guidance.
S1.00049 Understanding Charged Particle Backgrounds for GLAST. LINDSEY PERRY, Ohio State University. GLAST COLLABORATION — Gamma Ray Bursts (GRBs), are the brightest events in our universe and last anywhere between milliseconds to a few minutes. GRBs are thought to occur when a giant star collapses into a black hole, or when two neutron stars collide. The Gamma-Ray Large Area Space Telescope (GLAST) is a satellite mission which will detect gamma ray photons which come from GRBs as well as other astrophysical phenomena. Although GLAST is designed to detect gamma rays, approximately 90 percent of the events which are downlinked are background events such as protons, electrons, and positrons. A major limitation of GLAST is the limited allotted downlink bandwidth, and so understanding these backgrounds may allow us to improve both the background rejection and the signal to noise ratio of the resulting data. This analysis describes a technique for identifying backgrounds in the GLAST data, based on Artificial Neural Networks. Understanding the particle composition will help in the identification of true Gamma-rays, therefore impacting all science done with GLAST. GLAST is managed by NASA in partnership with the Department of Energy, and is scheduled to launch in early 2008.

S1.00050 Improving Campus Security with Increased Lighting Efficiency while Simultaneously Reducing Light Pollution, ANDREW SCHENK, DAM MILLER, ERIC MARTELL, Millikin University — Many outdoor lighting fixtures fail to enhance the security of the assets they were designed to protect; moreover, they simultaneously increase the levels of light pollution for astronomers. The problem is simple: most lighting fixtures do not properly aim the light they produce downward. In fact, up to fifty percent of the light rays escape upward, thus wasting a significant amount of energy and severely degrading the environment in which to do astronomy. To resolve these problems, I first created a scale model of Millikin University’s campus and took time exposures and photometer readings from the replicas of the existing light fixtures. I then fastened improved fixtures to the scaled lamps and retook the camera exposures and photometer readings for comparison. With this information I was able to take my work full scale and physically change one of the light fixtures on campus. Finally to wrap up my project I took my findings to safety and security to show the improvement that these new fixtures represented to Millikin’s safety and to its astronomy equipment.

S1.00051 Can Airports be a Green Source of Energy?1. DANIEL SOLUS, CHARYSYE ARCHER, BRANDI MALONE, NORRISCH T. CHESTERFIELD, LATERIA JACKSON, DANIEL ERENSO, Middle Tennessee State University — When Boeing 747 lands its energy (896MJ) is dissipated by friction. Our statistical analysis for commercial aircraft landing at the Nashville International Airport (BNA) have discovered that nearly 30 average single family households can be powered by the dissipated energy on a monthly basis. It may be possible to land an airplane on a frictionless surface and transform its energy into electrical energy. To demonstrate this we have conducted theoretical and experimental studies using a conducting rod attached to a toy car sliding on a U-shaped conducting wire placed in a uniform magnetic field track. The results concluded that this technique requires a very strong magnetic field. We then used a cylindrical magnet mounted on toy trucks and set to roll on a track inside a solenoid and been able to generate an ac voltage (4-10 volts).

1 This work is supported by NSF.

S1.00052 Dipole-Dipole Interaction of a Non-Linear Pendulum. VY TRAN, JASON RADEL, LAUREN EDGE, MARTIN JOHNSTON, University of Saint Thomas — We have studied the effect of adding a magnetic dipole to a chaotic pendulum. The dipole pendulum is subject to both gravitational and magnetic fields. The interplay between the shape of the potential well and the resulting motion is shown by Poincare sections in phase space and bifurcation diagrams in coefficient space. We have created computer models which integrate the differential torque equation. Using measured coefficients which describe the physical properties of the system and various drive frequencies, we have studied the correlation between predicted Poincare sections and experimental data. The fractal properties of the chaotic attractors in phase space have also been studied in an effort to quantify the complexity of the attractors.

S1.00053 Measuring Coefficients of Friction for Materials Commonly Used in Theatre. ROBERT MENTZER, ERIC MARTELL, Millikin University — When designing a stage setup for a theatrical presentation, designers must consider equipment, materials, cost and manpower, and we can use physics to simplify and enhance the process. Unfortunately, there is a lack of information about the properties of materials commonly used in theatre. The objective of this research was to determine the coefficients of static and kinetic friction for several materials commonly used in theatrical scene construction and the coefficients of rolling friction for a series of commonly used casters. Materials of known coefficients were tested to confirm the accuracy of the experimental process. Data was collected using a sled style apparatus and LabVIEW software. Data was analyzed in mass volumes using Microsoft Excel spreadsheets and macros. This research was performed as a part of the Physics of Theatre project, a joint collaboration between Millikin University and the University of Illinois at Urbana-Champaign, and was supported in part by Millikin, UIUC, and the United States Institute for Theatre Technology.

S1.00054 Modeling and Simulation of the Impact Response of Filled and Unfilled Linear Cellular Alloys for Structural Energetic Material Applications, ADAM JAKUS, ANTHONY FREDENBURG, NAARESH THADHANI, Georgia Institute of Technology — We are investigating the mechanics of impact-induced stress transfer between a linear cellular alloy (LCA) and a reactive filler to determine the effect of cell geometry on deformation and fragmentation. LCAs are honeycomb structures made of maraging steel, and provide structural integrity for the reactive filler such as a powder mixture of Ta+Fe3O4. 3-D computations are used to determine stress and strain distributions in both filled and unfilled LCAs during impact. The strength and failure models used for maraging steel and the response of Ta+Fe3O4 are validated through experiment. The failure response of three different geometries: 9-cell, pie, and reinforced pie, are compared with the response of a hollow cylinder, for impact velocities of 100, 200, and 300 m/s. Unfilled, the cylindrical geometry provides the least resistance to deformation and fragmentation, while the reinforced pie LCA provides the most resistance. Understanding of the mechanics of deformation and failure is used to determine the most effective geometry for stress transfer to the filler.

S1.00055 An Ab-Initio Study of Multiple Conformers of Glycine, DANIEL KAPLAN, HANYU ZHANG, Stevens Institute of Technology. — The recent combination of new computational chemistry techniques and high performance computational hardware is allowing unprecedented levels of accuracy in the calculations of physical quantities such as potential energy surfaces and rotational-vibrational spectra. In this work, we present calculations of the four most stable conformers of Glycine using the aug-cc-pVDZ basis set and Coupled Cluster Theory. We compare our calculations to experimental values and show that our current calculations differ by less than two percent from measured values, much better than results from previous years. When searching for molecules in the Interstellar Medium this small difference suggests that computational methods are becoming well-suited for the task. The natural question to ask is: at what point will the small deviation from experimental values render our computations just as reliable as experiments? We feel that the current results show that we are indeed close to this goal.

S1.00056 Arsenic adsorption and speciation in drinking water by GAC-based iron-containing adsorbents , YEWon GIM, JEFF TERRY, Physics Division, Illinois Institute of Technology, Chicago IL 60616, ZHIMANG GU, B. HUA, BAOLIN DENG, Department of Civil and Environmental Engineering University of Missouri, Columbia, Columbia MO 65211 — Granular Activated Carbon (GAC) with Iron adsorbents were developed for effective removal of arsenic from drinking water. The structure and proposed mechanism for As removal was studied using X-ray absorption spectroscopy. The oxidation state of As(III)/GAC sample was calculated using XANES spectra and verified to be predominantly As(V). The structure was determined using EXAFS spectra of As(V) and Fe. The Fe spectra suggested thin layer of Fe oxide formation on GAC surface. As data showed As oxide formed bond on the Fe oxide surface. The spectra were calculated using multiple geometrically optimized models calculated using density functional theory. Further calculations were done to verify the structure, and further examine the structure.
S1.00057 Formation of synthetic structures with micron size silica beads using optical tweezer

, JEREMY CURTIS, ADAM SHULMAN, SÁMUEL ELROD, DANIEL ERENSO — Colloidal particles, such as silica, are particles having size ranging between several nanometers and several millimeters and can be suspended in a liquid. Because of their tunability, in size, shape, as well as in chemical composition, and their ability to self-assemble they find applications in the development of advanced materials like photonic crystals. Typically, colloids self-assemble into face centered cubic or body centered cubic structures which determines their optical and electrical properties. The control over the structures of one-component colloids using array of optical tweezers, without changing the liquid chemical composition, is limited. If we cut off the laser, then the colloids will eventually lose their new structure. However, by changing the chemical composition of the liquid in which the colloids are suspended in and using optical tweezers, it is possible to assemble the colloids in a new stable structure which possibly results in new optical and electrical properties. In this work, we have demonstrated that micron-size silica beads can in fact be arranged in desired synthetic structure using an optical tweezer in a saline buffered solution. In a 3.1 micron silica colloids suspended in water we added the right concentration of NaCl to form a solution in which silica beads brought close to one another can bind by an adhesive electrostatic force without drifting away due to their thermal energy. Then by trapping and dragging one bead at a time using an optical tweezer, we have arranged the silica beads in one- and two-dimensional structures.

S1.00058 A hydrocolloid-based photoelastic modulator

, KYLE BRAUN, JAMES THEILEN, JAMES KAVANAUGH, CHRISTIAN LYTLE, ADAM GREEN, MARTIN JOHNSTON, University of St. Thomas — Birefringent gelatin and other hydrocolloids can serve as the optical elements of simple, inexpensive photoelastic modulators. Driven harmonically by a speaker coil, a small block of gelatin acts as a variable linear retarder and can thus be used to sinusoidally vary the polarization of a laser beam passing through it. We model this effect with Mueller matrices and show that our gelatin modulator behaves as predicted. This uncomplicated yet versatile device is well suited for several types of polarimetry experiments that do not require high precision, and it makes an excellent pedagogical tool for students in advanced undergraduate optics course.

S1.00059 Stock sheets of polycarbonate as inexpensive low-order optical wave plates

, JAMES KAVANAUGH, ADAM GREEN, University of St. Thomas — We show that commercially available transparent polycarbonate sheets often have linear retardances in the quarter- to half-wave range for visible light. Sheets with thicknesses from 1/16” to 3/16” act as zero- to third-order retarders that are modestly stable with temperature and uniform with position. By adjusting the sheets’ tilt and orientation angles, they can be tuned to desired retardances, although they are not as sensitive to these parameters as are higher-order wave plates. Since these sheets are readily available and inexpensive, these sheets make good candidates as easily machined, large-aperture wave plates for general laboratory use.

S1.00060 LRO, LEND and the Search for Water on the Moon

, JESUS CANTU, New Mexico State University — For complete abstract, please see session F1.

S1.00061 Improving the Higgs Mass Resolution by Using a Neural Network to Make Jet Corrections in the ZH \rightarrow 1+1-bb Channel

, JESSICA HANZLIK, The Ohio State University — For complete abstract, please see session F1.

S1.00062 Development of Neutron Diagnostics for 1 MA Z-Pinch

, CHRISTOPHER THOMAS, University of Nevada, Reno — For complete abstract, please see session F1.

S1.00063 Calibration and Installation of the UConn O-TPC at TUNL

, ALEXANDER YOUNG, University of Connecticut — For complete abstract, please see session F1.

S1.00064 Atmospheric Muon and Neutrinos in IceCube Neutrinos Observatory

, RYAN BIRDSALL, University of Wisconsin-Madison — The goal of the IceCube Neutrino Telescope is to detect high-energy neutrinos of extraterrestrial origins. The flux of neutrinos produced by the impact of cosmic rays in the Earth's atmosphere constitutes an irreducible foreground among which cosmic neutrinos are searched. Therefore the detailed measurement and knowledge of the atmospheric neutrinos is fundamental. Extensive air showers initiated by high energy cosmic ray particles have been simulated using CORSIKA generator, with Hoerandel polygonato model of cosmic ray spectrum and composition, and with three different high energy interaction models: QGSJET01, QGSJET-II, AND SIBYLL. With these models, the “conventional” muon and neutrino fluxes, i.e. from the decay of pions and kaons in the atmosphere, have been generated. The resulting muon bundle energy spectrum and mu+/-mu- ratio as a function of energy, is compared with various experimental results, such as MINOS, L3Cosmic, and other underground detectors, and with various mathematical calculations. Since muons and neutrinos are produced by the same physical processes, these direct comparisons are used to assess the dependency of neutrino flux on the different interaction models at energies above 1 TeV, i.e. relevant for IceCube. The prediction of mesons with charm quark is also discussed, since neutrinos produced by the decay of such mesons have harder spectrum than conventional neutrinos, and might mimic high energy extraterrestrial neutrinos in km$^3$ neutrino telescopes.

Monday, April 14, 2008 3:30PM - 5:18PM –
Session T2 DPB DPF: DPB/DPF Prize Session

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis D

3:30PM T2.00001 The Large Hadron Collider

, LYNDON EVANS, CERN — The Large Hadron Collider (LHC) at CERN is a proton-proton collider with a centre-of-mass energy of 14 TeV and is now in the final phase of hardware commissioning before the first beams are injected later this year. A brief description of some of the novel design features is given and the prospects for operation in 2008 are discussed.

4:06PM T2.00002 Accelerator PhD Thesis Prize

, RAMA R. CALAGA, —
4:42PM T2.00003 High Temperature Superconductor Prospects for Accelerators, DAVID LAR
BALESTIER, Florida State University — In spite of the great interest in applying HTS cuprate superconductors or MgB2 to electrotechnology, virtually all superconducting magnets made to date have been made from Nb-Ti or Nb3Sn. Despite their need for helium cooling, there are very good reasons for this – Nb-base wires are available in many designs and current capacities, twisted and filamentary, with overall current densities that are generally higher than any higher Tc materials, while also being strong and easily reinforced if greater strength is needed. They can operate in fields up to about 23T at 2K. But new developments, for even higher fields beyond the upper critical field (Hc2) of any Nb compound are focusing new attention on the Bi-2212 and YBCO cuprates and perhaps MgB2 too. Following the recommendations of the recent National Research Council Panel COHMag (Committee on High Magnetic Fields) and recent strong interest from the high energy physics community, new grand challenges of 30T NMR, 60T hybrid magnets and >50T solenoids for muon colliders are before the magnet community. To make such materials as practical conductors requires understanding and solutions to several grand challenges in the physics and materials science of vortex pinning, and grain boundary structure and properties, and the associated materials processing challenges required to make conductors that are km long. I will discuss some of the physics and materials challenges that such magnets pose and the recent progress that has got superconducting magnets to almost 30 T.

Monday, April 14, 2008 3:30PM - 5:18PM – Session T3 DNP: Bethe, Bonner Prize Session

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis E

3:30PM T3.00001 Hans A. Bethe Prize Talk: Nuclear Physics, Stellar Explosions and the Abundance Evolution in Galaxies, FRIEDRICH-K. THIELEMANN, University of Basel — The computational modeling of astrophysical objects requires the combined treatment of different subfields of physics for a complete description. 1. hydrodynamics/hydrostatics for the modeling of mass flows. 2. energy generation and nucleosynthesis for understanding the composition changes due to nuclear reactions and the related energy release. 3. energy transport via conduction, radiation or possibly convection, and finally 4. thermodynamic properties of the matter involved, especially the equation of state which creates a direct relation between energy release and hydrodynamic response via pressure and entropy. Nuclear physics obviously plays an essential role for energy generation and nucleosynthesis, but can also enter radiation transport (e.g. in supernovae) via neutrino-nucleon/ nucleus interaction and clearly determines the equation of state at nuclear densities (e.g. in neutron stars). In this review we want to highlight the role and impact of nuclear physics and its uncertainties on the explosion mechanism and/or the ejected abundances of type Ia and type II supernovae, novae and X-ray bursts, plus their imprint witnessed in the so-called chemical evolution of galaxies. Special emphasis is given to the properties of proton- as well as neutron-rich exotic nuclei far from stability.

4:06PM T3.00002 Tom W. Bonner Prize Talk: Elliptic Flow at RHIC, ARTHUR POSKANZER, Lawrence Berkeley National Laboratory — At the Relativistic Heavy Ion Collider (RHIC) it was found that the second harmonic of the anisotropic azimuthal particle distribution, called elliptic flow, was large, approaching the hydrodynamic limit. In a non-central collision of nuclei the initial overlap region of participants is lens shaped, but during expansion this initial anisotropy dissipates, and thus the elliptic flow reflects the early time of the collision. Also, the elliptic flow of the observed hadrons seem to scale with their number of quarks, indicating they are formed by coalescence of partons at early time. This large elliptic flow and its scaling are two of the pieces of experimental evidence for early equilibration and formation of a strongly coupled quark-gluon plasma with low shear viscosity - a perfect fluid.

4:42PM T4.00003 Quark-Gluon Plasma in QCD, at RHIC, and in String Theory, KRISHNA RA
JAGOPAL, MIT — The realization that the high temperature phase of QCD is quark-gluon plasma, with properties qualitatively distinct from those of the hadronic phase whose quasi-particles make up the quotidian world, goes back more than 30 years. Over that time, we have gained reliable insight into the thermodynamics of quark-gluon plasma at accessible temperatures from lattice QCD calculations, and we have understood much about its dynamics in the high temperature limit where it becomes weakly coupled. However, in the last five years experimental discoveries at the Relativistic Heavy Ion Collider have taught us that, at least at temperatures within a factor of two of that at which hadrons ionize, the dynamics of quark-gluon plasma is closer to the ideal liquid limit than to the ideal gas limit. These experimental data demand a theoretical understanding of the dynamics of strongly coupled quark-gluon plasma. Such calculations in QCD itself are in their infancy, but string theory provides us with robust tools for exactly this purpose, applicable to the quark-gluon plasmas of many QCD-like theories. I will describe some of the many new results obtained recently from these AdS/CFT calculations, qualitative insights already in hand, prospects for quantitative insights for those properties that turn out to be universal across many different strongly interacting quark-gluon plasmas, and the interplay with near-future data expected from RHIC and from the LHC heavy ion program.

Monday, April 14, 2008 3:30PM - 5:18PM – Session T4 GPMC: Electric Dipole Moment Experiments

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade B

3:30PM T4.00001 Search for a permanent electric dipole moment of the mercury atom, NORVAL FORSTON, University of Washington — There has been exciting progress in recent years in the search for a spin-aligned electric dipole moment (EDM) of atoms, molecules, and the neutron. Although such a time-reversal violating dipole has not yet been detected, highly touted theories of possible new physics, such as Supersymmetry, predict the existence of EDMs within reach of modern experiments. In 2001 our group published a precise limit on the EDM of the Hg atom: [d(Hg)] < 2.1 x 10^{-28} e cm. To further refine these measurements, we switched from two to a stack of four nuclear-spin-polarized Hg vapor cells. Two lie in parallel magnetic and anti-parallel electric fields, resulting in EDM-sensitive spin precession; the other two cells, at zero electric field, serve to cancel magnetic gradient noise and limit systematics due to magnetic impurities or leakage currents. To date, the statistical uncertainty for the new EDM data is 1.7 x 10^{-28} e cm. Constraining systematics to similar levels will thus yield an order of magnitude improvement over our previous measurement. The talk will highlight recent work and show our current results. This research is supported by NSF Grant PHY 0457320.3

4:06PM T4.00002 Measuring the electron electric dipole moment with cold Cs and Rb atoms in optical lattices, DAVID WEISS, Pennsylvania State University — We will describe an experiment to search for the electron electric dipole moment using laser cooled alkali atoms trapped in two parallel 1D optical lattices. We have completed the first step in the experiment, the transfer ~50% of the atoms from a MOT to the measurement region 90 cm above the MOT. Transfer is accomplished by a ballistic launch, using the 1D lattice as a transverse guide. Our experimental geometry minimizes many sources of possible systematic error, and we project an ultimate sensitivity of ~4x10^{-30} e cm, which would be a 400-fold improvement over the current experimental limit.

3This work was performed in collaboration with Fang Fang.
Search for the electron electric dipole moment, DAVID DEMILLE, Yale University — In most viable extensions to the Standard Model, the electron is predicted to have a time-reversal violating electric dipole moment (EDM) at, or within a few orders of magnitude of, the current experimental upper bound. Experimental searches for the electron EDM hence have the capability to probe CP-violation at TeV (and potentially much higher) energy scales. Our group is developing new techniques to measure the electron EDM, with the long-term potential for improved sensitivity by many orders of magnitude. We are now taking data on a first-generation experiment using electrons embedded in the polar molecule PbO, where the size of the observable effect due to the EDM is dramatically amplified by the intramolecular electric field. This talk will describe the current status of the PbO EDM experiment, as well as plans for future upgrades.

Supported by NSF Grant PHY0555462

Monday, April 14, 2008 3:30PM - 5:18PM –
Session T5 DAP DPF: Dark Energy Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade C

Supernovae as Probes of Dark Energy, PETER GARNAVICH, University of Notre Dame — No abstract available.

Cosmological tests of modified gravity vs. dark energy, BHUVNESH JAIN, University of Pennsylvania — Modifications of general relativity provide an alternative explanation to dark energy for the observed acceleration of the universe. We examine the relationships between perturbations in the metric potentials, density and velocity fields, and discuss strategies for measuring them using gravitational lensing and other probes of large-scale structure. We show how a broad class of gravity theories can be tested by combining these probes. The possible clustering of dark energy can mimic features of modified gravity theories. We consider the question: how conclusively can signatures of modified gravity be established in upcoming observational tests.

Large Scale Structure and Dark Energy, ROBERT NICHOL, University of Portsmouth — No abstract available.

Gravitational waves from black hole mergers: From waveforms to astronomy, SCOTT HUGHES, Massachusetts Institute of Technology — The merger of binary black holes is a key target for measurement by both ground and space-based detectors. Not only are their waves very loud, and hence promising targets for detection, but they are also information rich. Measurement of these waves can teach us a great deal about the system and environment that produced the binary system, making it clear that the measurement of these waves will provide a wealth of astronomically interesting data. In this talk, I will summarize this situation from the standpoint of measurements with the space-based LISA detector. LISA’s target waves come from the coalescence of massive black hole systems, in the range $10^4 - 10^7 M_{\odot}$; many of these systems will be at relatively high redshift ($z > 3$ or so). Measuring these waves will thus give insight into the cosmological growth and evolution of massive black holes; in particular, we expect to be able to determine the holes’ masses and spins with great precision, to determine the luminosity distance to the binary with high precision, and to locate the event on the sky with moderate precision. I will summarize what is known about how well these measurements can be done, and discuss how this information can be used to learn about the cosmological growth of black holes and possibly even help map the large structure of the universe.

Numerical Relativity and Black Hole Mergers, FRANS PRETORIUS, Princeton University — I shall review recent developments in the simulation of binary black hole systems, focusing on results of relevance to expected astrophysical systems and gravitational wave detection.

The Astrophysical Context of Black Hole Mergers, MICHAEL COLEMAN MILLER, University of Maryland — Mergers between two black holes are anticipated to be key sources of gravitational waves for ground-based and space-based detectors, depending on the masses of the holes. The fundamental process of merger depends only on the mass ratios and spins of the holes, rather than on their absolute masses. This scale-independence has been exploited in numerous successful numerical simulations over the past few years. However, many aspects of the astrophysical processes affecting these systems do depend on masses. Indeed, detection and characterization of these mergers can yield unique information about stellar evolution, dynamics at many scales, and even the evolution of structure in the universe as a whole. I will give an overview of these processes and discuss future directions to pursue.

Monday, April 14, 2008 3:30PM - 5:18PM –
Session T7 FEd: Excellence in Physics Education Award Session Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Rose Garden
hard spectrum with an exponential cutoff, with the most significant excess at a level of \(\sigma \times 10^4\). One of the regions has a different energy spectrum than the cosmic-ray background at a confidence level of \(\sigma \times 10^4\). This is difficult to explain since a 10 TeV proton in a 1 GeV field has a G field has a...
spin. Most of these actors were at Bohr’s institute in Copenhagen in 1926–27; their interaction plays a central role in this story.

estimates. Using this result, the American physicist David Dennison devised the modern theory in 1927, and in the process, found persuasive evidence for proton far ultraviolet. Further measurements by the Japanese spectroscopist Takeo Hori led to a moment of inertia for molecular hydrogen more than double earlier success. An experimental breakthrough came in 1926, when for the first time, spectral lines involving the ground state of molecular hydrogen were found in the persistent efforts. Then in 1926, Heisenberg showed that in the new quantum mechanics, identical particles must have either symmetric or antisymmetric in 1912, decreases sharply as the two rotational degrees of freedom freeze out. The “old quantum theory” could never explain this behavior satisfactorily, despite effects of geometric acceptance due to the magnetic field and an asymmetric detector. This data set allows an accurate measurement of the atmospheric muon charge ratio between 50 and 400 GeV to be performed.

We have measured the elemental abundances of galactic cosmic-ray Zn, Ga, and Ge using the CRIS instrument on the NASA-ACE spacecraft. These ultra-heavy (Z>29) nuclei are very rare and require an instrument with a large geometrical factor, such as CRIS possesses, exposed over a long period of time to collect a significant sample. Over the 10+ years since launch in 1997 we have collected ~250 nuclei with Z>29. Abundances for these elements measured over the energy range of ~150 to 600 MeV/nucleon will be presented and implications for the nature of the cosmic ray source will be discussed.

We present ongoing results of the spectrum and anisotropy of the 2005 January 20 GLE. Both isotropic and anisotropic particle distributions is completed and will be used to constrain the 2005 January 20 spectrum during the brief event onset as joint used to construct a time-dependent spectrum for GLE events unaffected by particle anisotropies. Modeling of the performance of both instruments to telescope in the Jemez Mountains near Los Alamos NM. Designed to image TeV g-ray sources, it is also sensitive to energetic solar particles above the local vertical overburden of 224.6 meters of water equivalent. The detector has collected charge separated atmospheric muons for a minimum of 37 days in both the forward and reversed Φ-field directions. Combining equal periods of forward and reversed field data, almost 40 million muons per sample, reduces the systematic effects of geometric acceptance due to the magnetic field and an asymmetric detector. This data set allows an accurate measurement of the atmospheric muon charge ratio between 50 and 400 GeV to be performed.

We have searched for correlations between the pointing directions of ultrahigh energy cosmic rays observed by the High Resolution Fly’s Eye experiment and active galactic nuclei visible in the northern hemisphere. None other than random correlations have been found. We report our results using search parameters prescribed by the Pierre Auger collaboration which have led them to conclude that a positive correlation exists for sources in the southern hemisphere. We also describe results using two methods for determining the chance probability of correlations: one in which a hypothesis is formed from scanning one half of the data and tested on another half, and another which involves a scan over the entire data set. The degree of auto-correlation in the data is consistent with isotropy. The largest correlation found occurred with a chance probability of 14%.

We present a description of the experiment, data acquisition, analysis and fits to the resulting spectra. The significance of the break in the spectrum is shown to be greater than 5 sigma.

The 2005 January 20 GLE Particle Spectrum. TREvor MORGan, CLIFF LOPATE, University of New Hampshire, MILAGRO COLLABORATION — Milagro is a ground-based TeV γ-ray telescope in the Jemez Mountains near Los Alamos NM. Designed to image TeV γ-ray sources, it is also sensitive to energetic solar particles above the local geomagnetic cutoff. It sits relatively close to the Climax neutron monitor in Colorado. Because of their geomagnetic proximity, these two instruments can be jointly used to construct a time-dependent spectrum for GLE events unaffected by particle anisotropies. Modeling of the performance of both instruments to both isotropic and anisotropic particle distributions is completed and will be used to constrain the 2005 January 20 spectrum during the brief event onset as well as the abrupt decay. We present ongoing results of the spectrum and anisotropy of the 2005 January 20 GLE.

Monday, April 14, 2008 3:30PM - 5:18PM –
Session T9 FHP: History of Physics Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade E

3:30 PM T9.00001 David Dennison, the specific heat of hydrogen, and the discovery of nuclear spin. CLAYTON GEARHART, St. John’s University (Minnesota) — The specific heat of hydrogen gas at low temperatures, first measured by Arnold Eucken in 1912, decreases sharply as the two rotational degrees of freedom freeze out. The “old quantum theory” could never explain this behavior satisfactorily, despite persistent efforts. Then in 1926, Heisenberg showed that in the new quantum mechanics, identical particles must have either symmetric or antisymmetric wave functions, and were the key to the spectrum of helium. Friedrich Hund first applied this concept to the rotational specific heat of hydrogen, with limited success. An experimental breakthrough came in 1926, when for the first time, spectral lines involving the ground state of molecular hydrogen were found in the far ultraviolet. Further measurements by the Japanese spectroscopist Takeo Hori led to a moment of inertia for molecular hydrogen more than double earlier estimates. Using this result, the American physicist David Dennison devised the modern theory in 1927, and in the process, found persuasive evidence for proton spin. Most of these actors were at Bohr’s institute in Copenhagen in 1926–27; their interaction plays a central role in this story.
3:42PM T9.00002 Grete Hermann: Mathematician, Physicist, Philosopher. CAROLINE HERZENBERG — When we look back at the history of quantum mechanics, we can find some scientists who in retrospect had significant roles but were unfortunately largely disregarded at the time. Among them was a very interesting woman, Grete Hermann, whose work in mathematics, philosophy, and physics took place mainly during the early to mid twentieth century. She is best known for discovering a flaw in John von Neumann's attempt at proof of the impossibility of hidden variable theory in quantum mechanics, but she also did further interesting work on the foundations of quantum mechanics. Her life, her collaboration with Emmy Noether, her involvement with Heisenberg's group in Leipzig, and some aspects of her further work in philosophy and education will be described briefly.

3:54PM T9.00003 Hermann Weyl: Between Mathematics, Physics, and Philosophy. PETER PESIC, St. John's College, Santa Fe, NM — Hermann Weyl introduced gauge theories into physics in the context of his extensions of general relativity. His important mathematical contributions to physics, particularly in quantum mechanics, which was significant as he considered how to respond to Einstein's criticisms of Weyl's unified field theory. Weyl's philosophical approach also affected his own research to quantum theory, very different from Einstein's. The way Weyl dealt with these dilemmas may illuminate this important part of the ways in theoretical physics and also show how philosophical reflection can be important in dealing with unsolved problems in physics.

1 Thanks to the John Simon Guggenheim Memorial Foundation for their support.

4:06PM T9.00004 Albert Einstein and Wernher von Braun - the two great German-American physicists seen in a historical perspective. FRIEDWARTD WINTERBERG, Univ of Nevada Reno — It was Albert Einstein who for the first time changed our view of the universe to be a non-euclidean curved space-time. And it was Wernher von Braun who blasted the trail to take us into this universe, leaving for the first time the gravitational field of our planet earth, with the landing a man on the moon the greatest event in human history. Both these great physicists did this on the shoulders of giants. Albert Einstein on the shoulders of his landsman, the mathematician Bernhard Riemann, and Wernher von Braun on the shoulders of Goddard and Oberth. Both Einstein and von Braun made a Faustian pact with the devil, von Braun by accepting research funds from Hitler, and Einstein by urging Roosevelt to build the atom bomb (against Hitler). Both of these great men later regretted the use of their work for the killing of innocent bystanders, even though in the end the invention of nuclear energy and space flight is for the benefit of man. Their example serves as a warning for all of us. It can be formulated as follows: "Can I in good conscience accept research funds from the military to advance scientific knowledge, for weapons developed against an abstract enemy I never have met in person?" Weapons if used do not differentiate between the scientist, who invented these weapons, and the non-scientist.

4:18PM T9.00005 William Band at Yenching University. DANIAN HU, The City College of New York — William Band (1906-1993) has been widely recognized by his American colleagues and students as "a fine physicist and teacher," who taught at Washington State University in Pullman between 1949 and 1971 and introduced Introduction to Quantum Statistics (1954) and Introduction to Mathematical Physics (1959). Not many, however, knew much about Band's early career, which was very "uncommon and eventful." Born in England, Band graduated from University of Liverpool in 1927 with an MSci degree in physics. Instead of pursuing his Ph.D. at Cambridge, he chose to teach physics at Yenching University, a prestigious Christian university in Beijing, China. Arriving in 1929, Band established his career at Yenching, where he taught and researched the theory of relativity and quantum mechanics, pioneered the study on low-temperature superconductivity in China, founded the country's first graduate program in physics, and chaired the Physics Department for 10 years until he fled from Yenching upon hearing of the attack on Pearl Harbor. It took him two years to cross Japanese occupied areas under the escort of the Communist force; he left China in early 1945. This presentation will explore Band's motivation to work in China and his contributions to the Chinese physics research and education.

This study has been supported the PSC-CUNY research award.

4:30PM T9.00006 In Franklin's Path: Establishing Physics at the University of Pennsylvania. PAUL HALPERN, University of the Sciences in Philadelphia — In 1751 Benjamin Franklin established the Academy of Philadelphia, the precursor of the University of Pennsylvania. Among its curricular mandates he envisioned included "Natural and Mechanic History," using a popular text he suggested by Noël Antoine Pluche that encompassed optics and celestial dynamics among its subjects. This talk will trace the history of physics research and education at Penn from its establishment, to the appointment of the first designated physics professor, George Frederic Barker, in 1873, to the opening of the Randall Morgan Laboratory in 1901 under the directorship of Arthur Goodspeed, and finally to the inauguration of the David Rittenhouse Laboratory in 1954 under the university leadership of Gaylord Harnwell.

4:42PM T9.00007 Scientific Revolutions to the nth power: n = 0, 1, 2, 3. JAMES BEICHLER, West Virginia Univ. at Parkersburg — Thomas Kuhn's description and characterization of scientific revolutions set the standard for interpreting and understanding these events, but his characterization introduced an anomaly. Newtonian science was at the pinnacle of its success immediately prior to the Second Scientific Revolution. From an evolutionary point-of-view, there were no crises to be solved just problems within the Newtonian paradigm, whereas the specific crises that initiated the revolution are evident from everyone's point-of-view after the revolution. This paradox is well recognized, but it seems to not to be a problem and is just ignored as if it were not important or significant. Yet this discrepancy strikes at the very heart of physics and the overall process of science. Historical conditions currently parallel the period immediately prior to the Second Scientific Revolution indicating that a new scientific revolution is approaching. When a comparison of the two periods is made, new characteristics of scientific revolutions are identified, the paradox is solved and evidence of a Zeroth Scientific Revolution emerges from the historical record.

5:06PM T9.00009 Well, It Was Big When We Built It!. VIRGINIA TRIMBLE, University of California Irvine & Las Cumbres Observatory — Many of the fundamental discoveries of astronomy were made with telescopes that we now regard as derisorally small, but which were often the largest and most expensive that then existed. Everything Galileo did obviously comes under this heading, but also the discovery of parallax with 8-10" telescopes and such by Bessel, Struve, and Henderson; the existence of external galaxies (1923, Hubble with the Mt. Wilson 60"), and the later expansion of the universe (1929, Hubble again, with th 100": the spiral structure of galaxies (Lord Rosse 1855 with a 72" speculum mirror); and the discovery of Neptune (Galile, another of those heliometers). There are also counterexamples of frontier work done with marginal facilities (the dominance of hydrogen in stars, from routine Harvard spectra examined by Payne; the first optical counterparts of a pulsar and a gamma ray burst with 36" telescopes - maybe even the same one - in Arizona). The talk will dash madly through the growth of telescope apertures, pausing briefly at a few interesting cases.
3:30PM T10.00001 Probing Lorentz Symmetry with Equivalence Principle Experiments, JAY D. TASSON, V. ALAN KOSTELECKY, Indiana University — A potential signal for new physics at the Planck scale is provided by Lorentz-symmetry violation. At presently accessible energies, these violations are described by the Standard-Model Extension (SME). An outline of matter sector of the SME in the presence of gravity will be provided, and new sensitivities to Lorentz violation attainable in Equivalence Principle experiments will be presented.

3:42PM T10.00002 SME Gravitational Tests, QUENTIN G. BAILEY, Embry-Riddle Aeronautical University, ALAN KOSTELECKY, Indiana University — The search for miniscule Lorentz-symmetry violations offers a promising experimental path to Planck-scale physics. A systematic effective field theory called the Standard-Model Extension (SME) describes general Lorentz violation and has been adopted for modern Lorentz-symmetry tests. In a recent work, the gravitational sector of the SME has been analyzed and sensitive experiments have been identified. In this talk, I will summarize theoretical and experimental aspects of this work. Recent low-noise laser ranging and atom interferometer experiments, which place the first stringent constraints on gravity coefficients for Lorentz violation, will be discussed.

3:54PM T10.00003 Constraints on Lorentz Violation with Precision Measurements of the Lunar Orbit, JAMES BATTAT, JOHN CHANDLER, CHRISTOPHER STUBBS, Harvard University — Efforts to unify the fundamental forces of nature have produced theories that violate Lorentz symmetry. The Standard Model Extension (SME) has emerged as a comprehensive theoretical framework which parametrizes Lorentz violations. The SME was recently extended to include gravitational interactions, and it was shown that existing Lunar Laser Ranging (LLR) data is sensitive to violations of Lorentz symmetry. LLR measures the Earth-Moon separation by timing the round trip travel of pulsed laser light from a telescope on the Earth to corner cube retroreflectors on the lunar surface. LLR has provided precision measurements of the Earth-Moon separation for nearly 40 years. We present an analysis of 35 years of LLR data and find no evidence for Lorentz symmetry violation at the part in 10⁻⁶ to 10⁻¹¹ level in these parameters. Forthcoming millimeter-precision LLR data from the Apache Point Observatory Lunar Laser-ranging Operation (see talk on APOLLO by Thomas Murphy) will further improve these constraints.

4:06PM T10.00004 Search for Lorentz Violation in a High-Frequency Gravitational Experiment Below 50 microns, JOSH LONG, WILLIAM JENSEN, SEAN LEWIS, Indiana University — We describe an ongoing experimental test of the inverse square law below 50 microns. The experiment uses 1 kHz planar oscillators as test masses with a metal membrane stretched between them to suppress backgrounds, a technique showing promise for probing exceptionally small distances and operation at the limit of instrumental thermal noise. Previous data from this experiment, which set new constraints on short-range phenomena motivated by string models, are being re-analyzed for possible signals of Lorentz violation in the Standard Model Extension.

4:18PM T10.00005 Test of the Equivalence Principle using Multiple Materials, TODD WAGNER, JENS GUNDLACH, STEPHAN SCHLAMMINGER, University of Washington — We present new results for a lab test of the equivalence principle. Our experiment uses a torsion pendulum with different composition test bodies arranged in a composition dipole and is mounted on a turntable that rotates with constant angular velocity. We present a combined analysis for Be-Ti and Be-Al composition dipoles, allowing us to constrain equivalence principle violations for charges based upon a linear combination of baryon number and lepton number. Additionally, we present preliminary results for test bodies that mimic the earth’s and moon’s compositions.

4:30PM T10.00006 Feasibility of measuring the Shapiro time delay over meter-scale distances, PETER SHAWHAN, University of Maryland, STEFAN BALLMER, LIGO - Caltech, SZABOLCS MÁRKÁ, Columbia University — The time delay of light as it passes by a massive object, first calculated by Shapiro in 1964, is a hallmark of the curvature of space-time. To date, all measurements of the Shapiro time delay have been made over solar-system distance scales using radio ranging. We show that the new generation of kilometer-scale laser interferometers being constructed as gravitational wave detectors, in particular Advanced LIGO, will be sensitive enough to measure the Shapiro time delay produced by a suitably designed rotating object placed near the laser beam. We show that such an apparatus is feasible (though not easy) to construct, present an example design, and calculate the signal that would be detectable by Advanced LIGO. This offers the first opportunity to measure space-time curvature effects on a laboratory distance scale.

The authors gratefully acknowledge support from the National Science Foundation, Columbia University, and the University of Maryland.

4:42PM T10.00007 A Conceptual Design for a 4-Satellite Mission to Monitor Variations in the Earth’s Gravitational Field, PETER L. BENDER, JILA/Univ. of Colorado — The GRACE mission has been monitoring time variations in the Earth’s gravitational field with much improved accuracy for the past 5 years. A similar follow-on mission to GRACE may fly soon after GRACE. However, it is of interest to explore what could be done in the future if as many as 4 satellites could be employed and they could be flown in a drag-free mode. Laser interferometry would be used between two pairs of satellites with separations of 50 to 100 km. One pair would be in a polar orbit, and the other in a considerably lower inclination orbit. High laser stability would permit high accuracy measurements of short wavelength gravity variations along orbit. A specific mission design that has been suggested to permit more detailed studies is as follows: 312 km altitude for both pairs; a polar orbit for pair-A, with a 79 rev repeat ground track; and a 62.7 deg. inclination for pair-B, with a 360 rev repeat ground track. Pair-B would have a 22.7 day repeat period, 110 km maximum track spacing at temperate latitudes, and many track crossings even near the equator. Pair-A would have a 5 day repeat period, which would help in monitoring fairly rapid variations in the Earth’s field.

4:54PM T10.00008 New Laser Technologies for Gravitational Wave Detectors, MIHAI BONDARESCU, Albert Einstein Institute, RUXANDRA BONDARESCU, Cornell, YANBEI CHEN, Caltech and Albert Einstein Institute, OLEG KOGAN, Caltech, ANDREW LUNDGREN, DAVID TSANG, Cornell — Thermal noise is expected to be the dominant source of noise in the most sensitive frequency band of second generation ground based gravitational wave detectors. Reducing it as much as possible is of paramount importance for increasing detector sensitivity and observing not only gravitational waves, but also quantum phenomena such as entanglement of 40 kg objects. Reshaping the beam to a flatter wider profile which probes more of the mirror surface reduces this noise. The “Mesa” beam shape has been proposed for this purpose and for a long time it has been regarded as the leading low-noise beam for LIGO. We have shown that thermal noise can be reduced by 12% with no additional effort by using finite mirror effects to our advantage rather than working against them. A reduction of 28% can be obtained by reshaping the mirror to coincide with the phase front of the real beam instead of a theoretical beam modeled with infinite mirrors. A drastic reduction in thermal noise by as much as 60% can be obtained by moving away from Mesa altogether and using a beam supported by conical mirrors that resemble the Bessel-Gauss beam. If the maximum 60% reduction in thermal noise is achieved, then in the most sensitive frequency band, LIGO will see up to three times more events.
Penn State — The Chern-Simons modification to General Relativity is an effective theory that represents both a low-energy limit of all string theories as well as loop quantum gravity. The main modification is the introduction of a parity-violating, Pontryagin term to the Einstein-Hilbert action, which has already been successfully employed to resolve the leptogenesis problem and anisotropies in the CMB. In this talk, I shall discuss gravitational probes of this modification, focusing on solar system experiments and gravitational wave tests. A parameterized post-Newtonian analysis will show that Chern-Simons gravity leads to a correction to gyroscopic precession that could be detected with Gravity Probe B or LAGEOS. A gravitational wave analysis leads to an “amplitude birefringence” effect that could be detected with gravitational wave interferometers, possibly leading to stronger tests of the modified theory. The proposed tests constitute gravitational probes of the quantum structure of spacetime on local and cosmological scales.

Monday, April 14, 2008 3:30PM - 5:18PM –
Session T11 DPF: Miscellaneous Searches II  
Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis B

3:30PM T11.00001 Search for Neutral Supersymmetric Higgs Bosons in $b\tau\tau$ Final States . KENNETH HERNER, SUNY, Stonybrook, D0 COLLABORATION — We report preliminary results in a search for neutral Higgs bosons via the channel $pp \rightarrow h+b \rightarrow \tau+\tau+b$ using 2 fb$^{-1}$ of data collected by the D0 experiment at the Tevatron. One tau is required to decay to a muon and a pair of neutrinos, and the other one to decay hadronically. The result is interpreted in terms of upper limits on the Higgs boson production cross section in supersymmetric models.

3:42PM T11.00002 A New Algorithm for Measuring the Energy of Hadronically Decaying Tau Leptons . ANDREY ELAGIN, ALEXEI SAFONOV, Texas A&M University, CDF COLLABORATION — We present a new technique for the accurate energy measurement of hadronically decaying tau leptons. This technique has been developed for use at the CDF experiment at the Tevatron. It is based on the particle flow algorithm complemented with a likelihood-based technique for separating contributions of spatially close particles. Based on Monte Carlo studies, this new approach is expected to improve the accuracy of the measurement by approximately a factor of two. In addition to superior energy resolution, this technique provides a direct estimate of the uncertainty on the energy measurement of individual tau candidates. While important in itself, this latter feature can serve as a powerful identification tool in distinguishing hadronically decaying tau leptons from jet and light lepton backgrounds. This new technique is expected to significantly improve the sensitivity of the $h \rightarrow \tau\tau$ search at the Tevatron.

3:54PM T11.00003 A Monte Carlo Study of NMSSM Higgs Searches at the Large Hadron Collider1 . ANIL SINGH, Fermilab/Panjab University, SUMAN BERI, Panjab University, Chandigarh, India, PUSHPALATHA BHAT, STEPHEN MRENNA, Fermilab, Batavia, IL 60510, USA, HARRISON PROSPER, Florida State University, Tallahassee, Florida — We present a Monte Carlo study of the potential to observe Higgs bosons in the Next-to-Minimal SuperSymmetric Model (NMSSM) at the Large Hadron Collider. We consider Higgs bosons that decay predominantly into a pair of light pseudoscalars (axions), which are kinematically constrained to decay into four tau leptons. The four-tau final state is important as it may arise in many models of new physics beyond the standard model where new light states form the dominant decay modes for the Higgs boson. The analysis we present is also applicable to many other models with extended Higgs sectors. The study has been confined to the axion mass range $2m_{\tau} < m_{a} < 2m_{\tau}$ so as to ensure that axions decay preferentially into tau leptons. This mass range provides a distinctive signal especially when the taus decay to electrons and muons.

1We thank the LHC Physics Center at Fermilab for support of Mr. Singh.

4:06PM T11.00004 Search for New Physics in the $\gamma+jets+X$ Final State . SCOTT WILBUR, HENRY FRISCH, DAN KROP, CARLA PILCHER, University of Chicago, RAYMOND CULBERTSON, SHIN-SHAN YU, Fermilab, CDF COLLABORATION — Given the large number of predicted and as-yet-unknown models of new physics, the first signals of new processes may appear in any final state. In this study we analyse the $\gamma+jets+X$ state. Without the constraints of a particular model prediction, we examine the kinematics of the events and compare to the standard model prediction. We use 1.8 fb$^{-1}$ of data collected by CDF at the Tevatron at $\sqrt{s} = 1.96$ TeV.

4:18PM T11.00005 Search for Anomalous Production of $\gamma+jets+E_T^{miss}$ . SAMANTHA HEWAMANAGE, JAY DITTMAN, NILS KRUMNACK, Baylor University, RAYMOND CULBERTSON, SASHA PRONKO, Fermilab, CDF COLLABORATION — Many new physics models predict mechanisms that could produce a $\gamma$ and jets signature. We search in the $\gamma+jets$ and $\gamma+jets+E_T^{miss}$ channels, independent of any model, for new physics using 2 fb$^{-1}$ of CDF Run II data collected at the Fermilab Tevatron from $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV. A variety of techniques are applied to estimate the standard model expectation and non-collision backgrounds. We examine several kinematic distributions including $E_T^{miss}$, $\Sigma E_T^{miss}$, and invariant mass for discrepancies with respect to the standard model.

4:30PM T11.00006 Search for Supersymmetry in the $E_T^{miss}+b$-jet Signature at CDF . MIGUEL VIDAL, OSCAR GONZALEZ LOPEZ, CIEMAT, CDF COLLABORATION — Using data collected with the CDF detector in Run II of the Tevatron, we search events containing two or more jets and missing transverse energy for the presence of physics beyond the Standard Model. At least one of the jets is required to be tagged as originating from a heavy-flavour quark. The analysis is optimized for sensitivity of the supersymmetric partner of the bottom quark produced from gluino decays. Preliminary results are presented, along with future plans for improvements in searches with this signature.

4:42PM T11.00007 Measurement of $Z\gamma$ Production at CDF . JIANRONG DENG, AL GOSHAW, CHRISTOPHER LESTER, TOM PHILLIPS, Duke University, BEATE HEINEMANN, Ernest Orlando Lawrence Berkeley National Laboratory, AI NAGANO, University of Tsukuba, CDF COLLABORATION — We present results from studies of photons produced in association with $Z$ bosons in $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV at the Tevatron. Tri-linear gauge couplings are fundamental predictions of the Standard Model, and studying these couplings provides a sensitive test for non-Standard Model interactions. Here we compare measurements using 2 fb$^{-1}$ of CDF data with Standard Model predictions and predictions from models containing anomalous couplings.

4:54PM T11.00008 Search for a scalar top quark at CDF . WILL JOHNSON, University of California, Davis, CDF COLLABORATION — For some regions of SUSY parameter space it is conceivable that the supersymmetric partner of the top quark (stop squark) could be the lightest squark, and could actually be less massive than the standard model top quark. Also, depending on the mass hierarchy of SUSY, a stop squark event might look nearly identical in the detector to that of a top quark event. The presence of such a light stop squark could easily go unnoticed due to the much lower production cross section of the scalar stop squark, as compared to the fermionic top quark. We present a search for the stop squark at CDF in the mass range 135 to 170 GeV. We look in the dilepton decay channel, that is a final state with two leptons, at least two jets, and large missing transverse energy. Using a weighting technique, we reconstruct the mass of the under-constrained stop squark events, and use the reconstructed mass to discriminate stop squark events from backgrounds. This new reconstruction technique provides a promising avenue to search for the stop squark.
5:06PM T11.00009 Single Top Production in Unparticle Physics

ABDULKADIR SENOL, AHMET TURAN ALAN, Abant Izzet Baysal University, NAMIK KEMAL PAK, Middle East Technical University — We study the single production of top quarks in $e^+e^-, \pi^\pm$ and $pp$ collisions in the context of unparticle physics through the Flavor Violating (FV) unparticle vertices and compute the total cross sections for single top production as functions of scale dimension $d_U$. We find that among all, LHC is the most promising facility to probe the unparticle physics via single top quark production processes.

1This work was supported by AIBU Research Fund under grant no 2005.03.02.216

Monday, April 14, 2008 3:30PM - 5:18PM —
Session T12 DPF: Accelerator Neutrino Expts. I

3:30PM T12.00001 Analysis of Neutral Current $\pi^0$ Events at MiniBooNE

COLIN ANDERSON, Yale University, MINIBOONE COLLABORATION — The current generation of neutrino oscillation experiments, such as the MiniBooNE electron neutrino appearance search, require excellent understanding of backgrounds from neutral current $\pi^0$ interactions. The electromagnetic signature of these events mimics that of charged current electron neutrino interactions, producing misidentified signal. This background will continue to be an important consideration for future long baseline electron (anti)neutrino appearance searches. The MiniBooNE experiment has collected the largest sample of neutrino interactions at $\sim 1$ GeV and antineutrino interactions overall to date, providing a wealth of data for neutral current $\pi^0$ production measurements. In this talk the current results of the neutral current $\pi^0$ analysis in both neutrino and antineutrino running will be presented.

3:42PM T12.00002 Measurement of $\nu_\mu$ and $\nu_e$ Events in an Off-Axis Neutrino Beam

ZELIMIR DJURCIC, Columbia University — The purpose of the MiniBooNE detector at Fermilab is to measure neutrinos from the Booster beamline. In the same time the MiniBooNE detector observes off-axis neutrinos from the NuMI/Minos beamline. These events are used to measure pion and kaon components of the NuMI beam. The data sample provide an important complementary analysis of the neutrino spectrum since the energy and distance is similar to the Fermilab Booster beam. We analyzed charged current quasi-elastic ($\nu_\mu n \rightarrow \mu^- p$) events that dominate at energies below 2 GeV. This sample is used to demonstrate our understanding of the beam. In the next step an enriched $\nu_e$ event sample ($\nu_e n \rightarrow e^- p$) was isolated. The NuMI events are dominated by intrinsic $\nu_e$ in low neutrino energy region and therefore subject to different systematics when compared to the Booster neutrinos. The results of the analyses will be presented.

3:54PM T12.00003 Predicting the Electron Neutrino Background Components at the MINOS Far Detector

JOSHUA BOEHM, Harvard University, MINOS COLLABORATION — The MINOS experiment has the potential to observe or set more stringent limits on the appearance of electron neutrinos. Critical to the ability to resolve a possible signal is an accurate prediction of the total background from all neutrinos at the MINOS Far Detector. Upon measuring the most significant background components at the MINOS Near Detector, it is possible to extrapolate and predict the number of background events expected at the MINOS Far Detector. The details of these techniques are discussed.

4:06PM T12.00004 Studies of the NuMI Neutrino Flux Using the Accompanying Muon Beam

LAURA LOIACONO, University of Texas Austin — In neutrino oscillation and interaction experiments, uncertainty in the flux of incident particles due to limited understanding of hadron production from nuclear targets is the largest contributor of systematic error to neutrino oscillation and cross-section measurements. We propose to measure the flux generated by the NuMI beam line by measuring the daughter muon flux produced in pion and kaon decays, $\pi^+ \rightarrow \mu^+ \nu_\mu$, $K^+ \rightarrow \mu^+ \nu_\mu$, and $K_L \rightarrow \pi^0 \mu^+ \nu_\mu$, using the muon monitoring system in the beam line. The longitudinal and transverse momentum of parent particles can be varied by moving the target longitudinally with respect to the focusing horns and by varying the current supplied to the horns providing a mechanism to map the momentum space of focused particles. The muon monitoring system consists of 3 arrays of 81 ionization chambers located approximately 720m downstream of the target. Muons must have a minimum energy of 4, 10 and 20 GeV to penetrate muon monitor 1, 2 and 3, respectively. Thus, the three monitors taken together can provide measure of the muon spectrum which is directly related to the parent pion and kaon flux off of the NuMI target.

4:18PM T12.00005 High Intensity Neutrino Oscillation Experiments and Exotic Particles

GEOFFREY MILLS, Los Alamos National Laboratory — Modern accelerator based neutrino experiments, those currently operating and those being proposed, use very intense beams to produce neutrinos. Those beams greatly surpass previous experiments in the number of protons on target and offer new opportunities for exotic particle searches. This paper discusses the discovery potential of current and future neutrino oscillation beams and experiments for weakly interacting neutral particles such as (pseudo)Goldstone bosons and gauge bosons which result from the spontaneous breakdown of grand unified theories particle physics.

4:30PM T12.00006 Eikonal contributions to Ultra High Energy Neutrino-Nucleon Cross Sections in Low Scale Gravity Models

ENRICO MARIA SESSOLO, DOUGLAS MCKAY, University of Kansas — We calculate low scale gravity effects on the cross section for neutrino-nucleon scattering at center of mass energies up to the Greisen-Zatsepin-Kuzmin (GZK) scale, in the eikonal approximation. We compare the cases of an infinitely thin brane embedded in 5 compactified extra-dimensions, and of a brane with a physical tension $M_S = 1$ TeV and $M_S = 10$ TeV. The extra dimensional Planck scale is set at $10^3$ GeV and $2 \times 10^6$ GeV. We also compare our calculations with pre-existing neutral current standard model calculations in the same energy range. New physics effects enhance the cross section by two order of magnitude on average. Moreover, in the thin brane limit, the full eikonal approximation results in a cross section an order of magnitude higher than in the corresponding saddle point approximation.

4:42PM T12.00007 Muon induced neutron study at medium depths underground

HYUNGHONG ANTONY LUK, The Chinese University of Hong Kong, ABERDEEN TUNNEL EXPERIMENT COLLABORATION — Muon induced neutron background is one of the most important backgrounds for many underground experiments, such as dark matter search and neutrino experiments. We have launched an experiment to study muon-induced neutron rate at the Aberdeen Tunnel Laboratory in Hong Kong, which has a 600 m.w.e. overburden. The overburden and rock composition of the Aberdeen Tunnel Laboratory are similar to those of the experiment halls of the Dayabay Reactor Neutrino Oscillation experiment, and thus our results will provide valuable information for the latter. A 650kg Gd-doped liquid scintillator neutron detector with muon tracker is used in this experiment. I will report on the progress of the Aberdeen Tunnel experiment as well as simulation results.
4:54PM T12.00008 Liquid Argon Time Projection Chambers: R&D Towards Kiloton Class Detectors, MITCHELL SODERBERG, Yale University, ARGONEUT COLLABORATION — Liquid Argon Time Projection Chamber (LAr TPC) detectors are ideally suited for studying neutrino interactions and probing the parameters that characterize neutrino oscillations. The ability to drift ionization particles over long distances in purified argon and to trigger on abundant scintillation light allows for excellent particle identification and triggering capability. Recent work in the development of LAr TPC technology for massive kiloton size detectors will be presented in this talk, including details of the ArgoNeuT (Argo Neutrino Test) test-beam project, which is a 175 liter LAr TPC exposed to Fermilab’s NuMI neutrino beamline. The first neutrino interactions observed in ArgoNeuT, as well as results from a commissioning run on the surface, will be presented. Proposals for the next generation of LAr TPC experiments, and the issues that must be confronted by these experiments, will be discussed.

5:06PM T12.00009 Neutrino Physics and LArTPC R&D with ArgoNeuT, JOSHUA SPITZ, Yale University, ARGONEUT COLLABORATION — Set to begin taking data in early 2008 in the on-axis NuMI neutrino beamline, ArgoNeuT is a Liquid Argon Time Projection Chamber (LArTPC) R&D stand for future CP Violation and νe/νμ neutrino oscillation searches. The first LArTPC to be placed in a “low” energy accelerator-based neutrino beam, ArgoNeuT will collect ~10^7 neutrino events per year in the 0.1-10 GeV range (peaking at 3 GeV). The GEANT4 simulation framework and physics capability of the detector will be presented. Including comparison to first events, simulation discussion will focus on using a dE/dx tag for electron and gamma separation, vital for νμ/νe tagging efficiency. Also, the possibility of ντ charged current quasi-elastic cross section and M_A parameter measurements will be discussed.

**Monday, April 14, 2008 3:30PM - 5:18PM**

Session T13 DPF: Precision Low Energy  Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis F

3:30PM T13.00001 Progress on Magnetic Trap Neutron Lifetime Experiment at Los Alamos, ALEXANDER SAUNDERS, Los Alamos National Lab, LANL NEUTRON LIFETIME COLLABORATION — A new neutron lifetime experiment has been designed and is now under construction at Los Alamos. This experiment eliminates material interactions of the neutrons by holding ultra-cold neutrons in a magnetic trap. The trap is closed on the top and sides by a high order multipole magnetic field produced by a Halbach array of permanent magnets and is closed on the top by gravity. The ultra-cold neutrons will be supplied by the source now operating at Los Alamos. Neutrons in quasi-bound orbits will be eliminated by the asymmetric shape of the trap. Approximately 10^6 neutrons will be stored per fill. First measurements of stored neutrons are expected in 2008. The design and construction status will be presented.

3:42PM T13.00002 Precision Neutron Polarimetry, MONISHA SHARMA, University of Michigan Ann Arbor, L BARRON-PALOS, Universidad Nacional Autonoma de Mexico, J.D. BOWMAN, ORNL, T.E. CHUOP, University of Michigan Ann Arbor, C. CRAWFORD, University of Kentucky, A. DANAGOUZIAN, A. KLEIN, LANL, S.I. PENITILLA, ORNL, A.F. SALAS-BACCI, W.S. WILBURN, LANL — Proposed PANDA and abBA experiments aim to measure the correlation coefficients in the polarized neutron beta decay at the SNS. The goal of these experiments is 0.1% measurement which will require neutron polarimetry at 0.1% level. The FnPB neutron beam will be polarized either using a He spin filter or a supermirror polarizer and the neutron polarization will be measured using a He spin filter. Experiment to establish the accuracy to which neutron polarization can be determined using He spin filters was performed at Los Alamos National Laboratory in Summer 2007 and the analysis is in progress. The details of the experiment and the results will be presented.

3:54PM T13.00003 Initial Asymmetry Results from the UCNA Experiment, ROBERT PATTIE JR, N.C. State University, UCNA COLLABORATION — In the decay of free polarized neutrons, there is an asymmetry in the emission direction of electrons with respect to neutron spin, which is related to A, the ratio of the axial-vector and vector coupling constants. By measuring this asymmetry and the neutron lifetime, it is possible to determine Vud, the first element of the CKM matrix. The UCNA collaboration will be the first to measure this asymmetry using ultra-cold neutrons, which allow for nearly 100% polarization and transport far from the source to reduce backgrounds. In 2007, all major systems required for a high precision measurement of the neutron beta-asymmetry were commissioned and a measurement with ≈ 3% statistical uncertainty was performed. Analysis of these initial results will be presented.

4:06PM T13.00004 UCN Polarization in the UCNA Experiment, A.T. HOLLEY, North Carolina State University — The goal of the UCNA experiment is to determine the angular correlation between the electron momentum and the neutron spin (the beta-asymmetry) in free neutron decay using polarized ultracold neutrons (UCN). The experimental strategy is to transport UCN into a decay volume through a 7T static magnetic field, allowing the magnetic potential to polarize the UCN. UCN polarization can then be reversed via an rf adiabatic spin-flipper which sits between the 7T polarizing field and the decay volume. This spin-flipper also allows an in situ measurement of the depolarized contamination which develops during a constant-polarization measurement cycle. In order to minimize this spin contamination the UCN guides leading to the decay volume, and the decay volume itself, are constructed of electropolished copper. Early in the 2007 run cycle measurements were made to determine the degree of polarization provided by the 7T polarizing field as well as the absolute efficiency of the spin-flipper. The results, together with the run-by-run depolarization measurements made during UCN data-taking, can be used to determine the average depolarized fraction present during our beta-asymmetry measurements. Details of the polarization measurements and the limits they place on the spin contamination present in UCNA will be discussed and compared to expectations from Monte Carlo transport models.

4:18PM T13.00005 Production of Ultracold Neutrons for the UCNA Experiment, RAYMOND RIOS, Los Alamos National Lab, UCNA COLLABORATION — Ultracold Neutrons (UCN) have temperatures below about 4mK and energies below about 300 neV. At this temperature, the neutron energy is within the Fermi surface potential range of some materials making it possible to transport and bottle neutrons which can be used for extremely low background neutron beta decay measurements. The UCNA collaboration has been commissioning a UCN source which incorporates moderating spallation neutrons off a tungsten target at the Los Alamos National Lab’s 800 MeV proton beam facility, LANSE, for polarized beta decay measurements. In the past year changes to the source have lead to more than an order of magnitude increase in UCN out into the experiment, making a significant step towards realizing a high precision UCN beta-asymmetry measurement. We will present an overview of the UCN source, the specific contributions of each of the major improvements from last year, and improvements planned for the 2008 run cycle.

1Supported by Los Alamos LDRD Funding

3for the UCNA Collaboration

1This work was supported by the US Department of Energy
4:42PM T13.00007 Studies on Magnetometry and Samples used for an Experimental Search on the Electric Dipole Moment of the Electron using Solid-State Techniques, YOUNG JIN KIM, CRAIG HUFFER, Indiana University, Bloomington, MACIEJ KARCZ, CHEN-YU LIU, GOVERDHAN REDDY, Indiana University, Bloomington — A discovery of a permanent electric dipole moment of the electron (eEDM) at the current sensitivity level will imply new sources of CP violation beyond the standard model of particle physics. We are attempting to improve the experimental limit of the eEDM using a new technique employing solid-state systems at low temperatures. The experiment requires a system with a large magnetic response and the application of sensitive SQUID magnetometry. In this talk, I will present results in characterizing the magnetic properties of our solid-state sample, polycrystalline Gadolinium Gallium Garnet (GGG), and discuss preliminary results of systematic studies on our SQUID detectors. In our current setup, SQUID sensors record a non-zero change in magnetic flux with no GGG samples. This non-zero signals indicate sources of systematic effects which mimic EDM signals. We identified that several sources are responsible for producing systematic errors: the eddy current and the transient current. The dominant effect due to the eddy current can be reduced by using electrode material with a high resistivity, such as graphite.

4:54PM T13.00008 Studies of Electrical Breakdown in Pressurized Superfluid Helium-4 for the SNS Neutron Electric Dipole Moment Experiment, MACIEJ KARCZ, CRAIG HUFFER, YOUNG JIN KIM, CHEN-YU LIU, JOSH LONG, Indiana University — Investigation of the dielectric strength of liquid helium (LHe) is motivated by the search for the electric dipole moment of the neutron (nEDM) at the Spallation Neutron Source (SNS). The SNS nEDM experiment uses a magnetic resonance technique on neutrons in a working medium of LHe. To achieve sensitivity of nEDM to the level of $10^{-25}$ e·cm, it requires an electric field of 50 kV/cm applied inside LHe. Prior results indicated that sustaining such a field in superfluid LHe at sub-Kelvins might be problematic. We are carrying out detailed electrical breakdown studies at Indiana University Cyclotron Facility. Results of measurements show that the specified field can be repeatedly applied to de-pressurized superfluid helium at temperatures as low as 1.7 K using a pressurization cycle. The observed hysteretic behavior has never been reported and we are working towards understanding the mechanism.

4:18PM T14.00005 A Measurement of the Photon Energy Spectrum in $b \rightarrow s\gamma$ Decays, LUKE WINSTROM, University of California, Santa Cruz Institute for Particle Physics, BABAR COLLABORATION — The photon spectrum in the $B \rightarrow X_s\gamma$ decay, where $X_s$ is any strange hadronic state, is studied using a data sample of $B\Bar{B}$ decays collected from 1999-2006 with the BaBar experiment. The spectrum is used to measure the partial branching fractions and the first and second moments for different $E_\gamma$ thresholds above 1.9 GeV.

4:30PM T14.00006 ABSTRACT WITHDRAWN

4:42PM T14.00007 Current Status of the XENON10 Experiment, AARON MANALAYSAY, University of Zurich, XENON COLLABORATION — The XENON10 experiment is the first-phase of the XENON dark matter direct detection program. The detector is a 10 kg dual-phase liquid xenon time projection chamber, recording energy deposition in the form of scintillation and ionization, produced when particles interact with the xenon atoms. In this manner, the detector is able to discriminate between electronic and nuclear recoils, with background-rejection power better than 99%. Deployed at the Gran Sasso underground laboratory in Assergi, Italy in the summer of 2006, the detector collected science data from August 2006 through October 2007, stopping sporadically for calibrations and an upgrade. I discuss results of the latest analyses for WIMP-nucleon cross sections.

4:54PM T14.00008 A Search for Dimuon Decay into Charged Kaons, MICHAEL LITOS, Boston University, SUPER-KAMIOKANDE COLLABORATION — The result of a search for dimuon decay, $pp \rightarrow K^+K^-$, in $^{16}O$ using the Super-Kamiokande detector, is presented. Modes such as this are motivated by R-Parity violating modes of Supersymmetry, and can be used to constrain the parameter $\lambda_{uds}$.

5:06PM T14.00009 Recent Proton Decay Results from Super-Kamiokande, JENNIFER RAAF, Boston University, SUPER KAMIOKANDE COLLABORATION — Recent experimental limits on the search for nucleon decay are presented. Data from Super-Kamiokande, a water Cherenkov detector with a fiducial volume of 22,900 tons of ultra pure water, are used in the analysis. Analyses from SK-I (40% photomultiplier coverage) plus SK-II (20% photomultiplier coverage) are reported.

Monday, April 14, 2008 5:30PM - 7:00PM - Session U11 DPF: DPF Town Hall Meeting: A New Era for Particle Physics Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis B

5:30PM U11.00001 DPF Town Hall Meeting: A New Era for Particle Physics, DENNIS KOVAR, U.S. Department of Energy, CHARLIE BALTAY, Yale University — Presentations by Dennis Kovar and Charlie Baltay followed by discussions.

Tuesday, April 15, 2008 8:30AM - 10:18AM - Session V1 APS: Plenary Session III Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis DE

8:30AM V1.00001 Exoplanets: Interiors, Atmospheres, and the Search for Habitable Worlds, SARA SEAGER, Massachusetts Institute of Technology — For centuries people have wondered, “Are we alone?” With over 250 exoplanets known to orbit nearby stars, this question has moved from science fiction to mainstream study. Now that the existence of exoplanets is firmly established, a new era of “exoplanet characterization” has begun. A subset of exoplanets—called transiting planets—pass in front of their stars as seen from Earth. Transiting planets have opened a whole new opportunity for exoplanets, because their physical properties, including average density and basic atmospheric properties, can now be routinely measured. The race to find habitable exoplanets has accelerated with the realization that big Earths orbiting small stars can be both discovered and characterized with current technology. These ideas will lead us down a path to the ultimate goal of space-based discovery and characterization of Earth analogs.

9:06AM V1.00002 New Paths to Fundamental Physical Law, ROBERT CAHN, Lawrence Berkeley National Laboratory — The field formerly known as High Energy Physics is less and less confined to experiments conducted at accelerators. While it will likely take the Large Hadron Collider at CERN to find the Higgs boson or its surrogates, we are using very different techniques to explore other unknown parts of the Standard Model and the 95% of the universe that lies outside it. The unanswered questions lead to experiments 2.5 km below the earth’s surface and ones 1.5 million km above it. In these ventures, particle physicists will join with nuclear physicists, astrophysicists, and astronomers to try to answer that question of interest to five-year olds and sages alike: what is the universe made of?

9:42AM V1.00003 Probing matter at the extremes: new frontiers in high energy density physics, BRUCE A. REMINGTON, Lawrence Livermore National Laboratory — The ability to experimentally study scaled aspects of the explosion dynamics of core- collapse supernovae (massive stars that explode from the inside out) or the radiation kinetics of accreting neutron stars or black holes on high energy density (HED) facilities, such as high power lasers and magnetic pinch facilities, is an exciting scientific development over the last two decades. [2] Additional areas of research that become accessible on modern HED facilities are studies of fundamental properties of matter in conditions relevant to planetary and stellar interiors, protostellar jet dynamics, and with ultraintense short-pulse lasers, strong field effects, possibly relevant to gamma-ray burst dynamics. With the added tool of thermonuclear ignition on the National Ignition Facility, excited state (“multi-hit”) nuclear physics studies, possibly relevant to nucleosynthesis, may also become possible. Techniques and methodologies for studying aspects of the physics of such extreme phenomena of the universe in submillimeter scale parcels of matter in the laboratory will be discussed. [2] “Experimental astrophysics with high power lasers and Z pinches,” B.A. Remington, R.P. Drake, D.D. Ryutov, Rev. Mod. Phys. 78, 755 (2006).

3This work was performed under the auspices of the Lawrence Livermore National Security, LLC, (LLNS) under Contract No. DE-AC52-07NA27344.

Tuesday, April 15, 2008 10:45AM - 12:33PM — Session W2 DPF DPB: The LHC/ILC Era Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis D
10:45AM W2.00001 Status of the LHC Detectors, FABIOLA GIANOTTI, CERN — The Large Hadron Collider (LHC) will start operation in Summer 2008 at CERN. I will review the status of the experiments, and describe the presently-ongoing commissioning activities with cosmic runs. I will then discuss examples of physics measurements to be performed with the very first data in 2008-2009.

11:21AM W2.00002 LHC Upgrade Paths, DANIEL MARLOW, Princeton University — Even though CERN’s Large Hadron Collider (LHC) has yet to commence operation, serious plans are already being laid for its upgrade. It is expected that the first few years of LHC operation will elucidate the basic mechanisms for electroweak symmetry breaking, and in doing so will lead to new questions of fundamental interest. Plans therefore call for a phased upgrade of the LHC, culminating in a ten-fold increase in its luminosity by roughly 2015. To make efficient use of this new discovery potential, the detectors at the LHC also need to be upgraded. This talk will review the physics opportunities as well as plans for upgrading the accelerator and the detectors. The possibility of doubling the energy of the LHC will also be discussed.

11:57AM W2.00003 Complementarity of the LHC and ILC, HEATHER LOGAN, Carleton University — Physics at the Large Hadron Collider (LHC) and the International e⁺e⁻ Linear Collider (ILC) will be complementary in many respects, as has been demonstrated at previous generations of hadron and lepton colliders. This talk will address the anticipated interplay between the LHC and ILC in testing the Standard Model and in discovering and determining the origin of new physics, with examples from models of weak and strong electroweak symmetry breaking, supersymmetric models, new gauge theories, models with extra dimensions, and electroweak and QCD precision physics.

Tuesday, April 15, 2008 10:45AM - 12:33PM —
Session W3 DNP: Recent Developments in the Structure of Exotic Nuclei

10:45AM W3.00001 Measurements of magnetic moments of excited states in nuclei far from stability, NOEMIE BENZCER-KOLLER, Rutgers University — Magnetic moments of nuclear states provide information on their microscopic structure as a function of energy, spin and temperature and reveal subtle interplay between single particle and collective nuclear excitations. Advances in technology have made it possible to measure magnetic moments of states with lifetimes ranging from hours to tens of femtoseconds. In addition, the current availability of radioactive beams and the future promise of intense beams of nuclei far from stability have opened new regions of the nuclear chart to the investigations of the nucleon-nucleon interactions in exotic nuclei. The main element of these experiments is provided by the hyperfine interaction between fast moving spin-aligned nucleons and polarized electrons in ferromagnetic materials. The new techniques that have been recently developed for application in radioactive environments will be discussed. The results of experiments carried out, at low and intermediate energies, on radioactive beams of 132Te, 76Kr and 38,40Ar, produced at ISOL or fragmentation facilities, will be presented and the future prospects of the field will be outlined. This work was supported in part by the US National Science Foundation.

11:21AM W3.00002 Neutron-Proton Coupling and the Lifetime of the First Excited State in 16C, PAUL FALLON, Lawrence Berkeley National Laboratory — Nuclei near the valley of β-stability have strongly correlated proton and neutron spatial distributions. This need not be the case for nuclei with a large excess of one nucleon type and the search for new phenomena and structure effects due to the “decoupling” of neutrons and protons is of great interest in nuclear structure physics. Cited examples of decoupled behavior include neutron-halo nuclei with measurably different proton and neutron radial distributions, and low-energy dipole modes such as “pygmy” resonances where, simplistically, a core of equal numbers of protons and neutrons oscillates against the excess neutron “skin”. Recently, another example was suggested to occur in 16C where the measurement of an anomalously quenched B(E2; 2+→0+) value of 0.63 e²fm⁴ combined with a large nuclear deformation led to the suggestion that the 16C valence neutrons were decoupled from its near-spherical proton core (N.Imai et al., PRL 92 (2004) 062501; Z.Elekes et al., PLB 586 (2004) 34; H.J.Ong et al., PRC 73 (2006) 024610). In this talk I will discuss a new lifetime measurement for the first-excited 2⁺ state in 16C carried out at the LBNL 88-Inch Cyclotron using the Recoil Distance Method and 9Be(9Be,2p) fusion-evaporation reaction. The mean lifetime was found to be 11.7(20) ps corresponding to a B(E2) of 4.15(73) e²fm⁴, consistent with other even-even closed shell nuclei and neighboring systematics. Our result does not support the interpretation of decoupled protons and neutrons in 16C. The revised value provides an important benchmark for theory. Time permitting I will present results on the neutron-rich nuclei 19Ne produced in a 2p knockout reaction performed at the NSCL using the 5800 spectrometer and ScgA gamma-ray detector. The measured (quenched) 2p knockout cross-section, when compared to theory, suggests a significant difference in the neutron intruder content between 12Mg and 30Ne, contrary to current shell models.

Tuesday, April 15, 2008 10:45AM - 12:33PM —
Session W5 GGR DAP: Computational Challenges in Astrophysics, Cosmology and Gravitation

10:45AM W5.00001 Neutron stars in binaries, status and a bright future, LUIS LEHNER, Louisiana State University — Neutron stars in compact binaries not only are important sources of gravitational waves but are also thought responsible for powering fascinating phenomena. Simulations studying these systems have already revealed interesting dynamics even when all relevant physical processes could not be incorporated. This talk will provide a broad picture of what has so far been achieved, highlight particular examples and argue the (near) future promises to be quite exciting.
11:21AM W5.00002 Computing Gravity’s Strongest Grip , DEIRDRE SHOEMAKER, Penn State University — Gravitational physics is entering a new era, one driven by observation, that will begin once gravitational wave interferometers such as LIGO make their first detections. The gravitational waves are produced during violent events such as the merger of two black holes. The detection of these waves or ripples in the fabric of spacetime is a formidable undertaking, requiring innovative engineering, powerful data analysis tools and careful theoretical modeling. In support of this theoretical modeling, recent breakthroughs in numerical relativity have lead to the development of computational tools that allow us to explore where and how gravitational wave observations can constrain or inform our understanding of gravity and astrophysical phenomena. I will review these latest developments, focusing on binary black hole simulations and the role these simulations play in our new understanding of physics and astronomy where gravity exhibits its strongest grip on our spacetime.

11:57AM W5.00003 Computational Astrophysics at the Petascale: Towards Three-Dimensional Supernova Modeling , RAPH HIX, Oak Ridge National Laboratory — The multi-scale and multi-physics character of many problems in astrophysics make them ideal candidates for investigation through large-scale simulations on modern supercomputers. Among the most computationally demanding of these problems is the explosion mechanism and phenomenology of core-collapse supernovae. The panoply of physical inputs, the time and length scales involved, and the necessity of performing simulations in three spatial dimensions makes supernova modeling among the most challenging subfields of computational science. I will review these latest developments, focusing on supernova simulations in three spatial dimensions incorporating all the requisite physical inputs known to be important today.

Tuesday, April 15, 2008 10:45AM - 12:33PM —
Session W7 DAP: Astrophysics Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Rose Garden

10:45AM W7.00001 Maria Goepert-Mayer Award Talk: Formation and Evolution of Compact Objects in Binary Systems , VICKY KALOGERA, Northwestern University — Ever since their discovery, first as X-ray sources and later as radio pulsars, binary stellar systems harboring neutron stars or black holes have been pivotal in our efforts to understand the formation and evolution of these most compact objects and the implications for gravitational wave searches. I will review some recent surprising results linking the formation of neutron stars and black holes. I will also discuss how studies of double compact objects can help uncover the origin of short gamma-ray bursts and assess the prospects for gravitational wave detections in the near future.

11:21AM W7.00002 LeRoy Apker Award Talk: The Velocity Structure of Galaxy Clusters , MATTHEW BECKER, University of Chicago — The phase space distribution of galaxies in and around galaxy clusters encodes fundamental information about cluster formation, mass, and structure. Using the maxBCG cluster catalog, produced from imaging data in the Sloan Digital Sky Survey, we study the BCG-galaxy velocity correlation function. By understanding its non-Gaussianity, we model the distribution of velocity dispersion at fixed richness and compute the velocity dispersion function. Like the cluster mass function, the velocity dispersion function can be used to understand cosmology and structure formation. Additionally we measure the segregation of galaxies in velocity space as a function of various observable properties.

11:57AM W7.00003 The Large Synoptic Survey Telescope , IAN SHIPSEY, Purdue University — Recent technological advances have made it possible to carry out deep optical surveys of a large fraction of the visible sky. Such surveys enable a diverse array of astronomical investigations including: the search for small moving objects in the solar system, studies of the assembly history of the Milky Way, and the establishment of tight constraints on models of dark energy using independent observations. The Large Synoptic Survey Telescope (LSST) is the most ambitious project of this kind that has yet been proposed. With an 8.4 m primary mirror, and its 3.2 Gigapixel, 10 square degree camera, LSST will provide a nearly an order of magnitude improvement in survey speed over all existing surveys, or those which are currently in development. Over its ten years of operation, LSST will survey 20,000 square degrees of the sky in six optical colors down to 27th magnitude. At least a thousand distinct images will be acquired of every field, enabling a plethora of statistical investigations for intrinsic variability and for control of systematic uncertainties in deep imaging studies. In this talk some of the science that will be made possible by the construction of LSST and a brief overview of the technical design will be given.

Tuesday, April 15, 2008 10:45AM - 12:33PM —
Session W10 GGR: Alternative Gravity I Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis A

10:45AM W10.00001 Relativistic Thermodynamics: Theory and Computer Experiment , CONSTANTIN RASINARIU, Columbia College Chicago — A thermodynamic system in uniform translation appears to a stationary observer to be a) colder $T = T_0/\gamma$ according to Planck and Einstein (1907), or b) hotter $T = T_0\gamma$ according to Ott (1963), where $\gamma = (1 - v^2/c^2)^{-1/2}$. The heated debate regarding the laws of transformation for the relativistic quantities is yet to be settled. In this paper I address the relativistic law of transformation of the temperature from the perspective of imposing the relativistic covariance of the fundamental laws of thermodynamics. Also, I report results from computer simulation of fully relativistic 2-dimensional molecular dynamics. I conclude that Jüttner distribution is well reproduced experimentally and I investigate the relativistic law of transformation of the temperature.

10:57AM W10.00002 Suggested Applicability of Position Varying G Theory When the Time Variation is Small , JOHN JAMES, St. Louis University — The Dicke-Sciama equation for $G$, where $\frac{1}{G} = \sum_{\mu=0}^{\infty} \frac{\mu R c^{2\mu}}{2\mu!}$, is summed over the mass of the universe not receding faster than the speed of light, can be derived from simple application of special relativity. $G$ is then a function of the position of matter but $G$ need not be varying with time in a significant way. The time variation due to Hubble expansion can be eliminated by new matter contributing to the sum above due to the slowing of the expansion. The time rate of change due to motion of the earth through the galactic plane is nearly comparable to the $\frac{dG}{dt} = \frac{10^{-11}}{yr}$ constraint from experiment. Position variation of $G$ from the DS equation explains the dark matter problem and type II population stars in a consistent manner. A reversal of the Carter analysis, in which there is a sensitivity of cosmic phenomena to physical constants, suggests a window on the observable portions of the universe. Only the portions of the universe where $G$ is within a few percent of the value measured in our solar system are visible. The carter window analysis can be extended to explain the variation of heavy elements in stellar populations since supernovae of such elements is also a very sensitive function of $G$.

11:09AM W10.00003 Higher Dimensional Gauss-Bonnet FRW Cosmology , CHAD MIDDLETON, Mesa State College, KEITH ANDREW, BRETT BÖLEN, Western Kentucky University — We examine the effect on cosmological evolution of adding a Gauss-Bonnet term to the standard Einstein-Hilbert action for a $(1 + 3) + d$ dimensional Friedman-Robertson- Walker (FRW) metric. By assuming that the additional dimensions compactify as a power law as the usual 3 spatial dimensions expand, we solve the resulting dynamical equations and find that the solution may be of either de Sitter or Kasner form depending upon whether the Gauss-Bonnet term or the Einstein term dominates.
11:21 AM W10.00004 Reconciling “Frozen Star” and “Point Singularity” Models of Black Holes. EMMETT REDD, Missouri State University — Kevin S. Brown gives a good discussion of the formation and growth of black holes (BH). However, he does not reconcile the “frozen star” (corresponding to the “field interpretation” of Weinberg) and the “point singularity” ("geometric interpretation" of Misner/Thorne/Wheeler) models. His main concern is “there is no known mechanism for” a frozen star’s mass to “have been pushed outward”. However, no push is required because all event horizons (little ones, big ones, or growing ones) are at the same potential energy level. He correctly claims that the BH’s mass “is in two places (both inside and outside the event horizon) at the same coordinate time,” and that the event horizons are surfaces of future null infinity. These three facts reconcile the models and leads to more satisfactory answer to how gravity gets out of a BH, i.e., it does not have to get out; it exists outside the event horizon until future null infinity. And, at the same coordinate time, it is at the point singularity, creating the event horizon. 1. http://www.mathpages.com/rr/s7-02/7-02.htm.

11:33AM W10.00005 Hilbert Versus GEM Action Smackdown. DOUG SWEETSER, None — In 1915, Hilbert wrote the action used for gravity:

\[ S_{GR} = \int \sqrt{-g} d^4x \]

As an amateur, I have worked on an alternative that unifies gravity and EM. Proposed in 2001, the action has been smashed down, only to come back with required alterations to its present form:

\[ S_{GEM} = \int \sqrt{-g} d^4x (-J^a A_{aL} + J^a A_{aL}) - \frac{1}{4} (\nabla^a A^c \nabla^c A^a - \nabla^a A^c \nabla^c A^a - \nabla^a A^c \nabla^c A^a - \nabla^a A^c \nabla^c A^a)
\]

The two actions will be contrasted because they make different predictions for light bending around the Sun at second order PPN accuracy, and for the polarization of quadrupole moment gravity waves.

11:45AM W10.00006 Time and Consistent Relativity Theory. LYUBOMIR T. GRUYITCH, Retired — Physical reality permitted to characterize clearly and fully the properties of time. They imply both the physical sense of time relativity and the mathematical fundamentals of a new, consistent, relativity theory. New formulae for temporal and spatial coordinates express time independence of space, which is a priori rejected in Einstein’s theory. They and those for velocity and acceleration, as well as for mass, force, and energy, are crucially different from Einstein’s formulae in the general case. The values of all variables in them are consistent relative to scales and units, but not in Einstein’s. In the special case the formulae take the known form, but rest still more general than Einstein’s. They reduce to Einstein’s in the particular singular case determined by Einstein’s assumptions. A proved result of the theory is that for every speed, not only for the light speed, we can define easily co-ordinate transformations such that the chosen speed is invariant relative to the transformations. Such transformations for the light speed are the Lorentz transformations. The Lorentz-Einstein invariance of the light speed is neither the property of light nor of its speed.

11:57AM W10.00007 $E=2mc^2$. KWADWO DOMPREH, University of Cape Coast — The Albert Einstein mass-energy equation $E = mc^2$ which is used primarily in the estimation of the amount of energy in fusion reaction can be can be modified to give an equation which is used calculate the amount of energy in a fusion reaction. This theory is deduced using the Gedenken experiment used in special relativity and a computer simulation using the Matrix library. The energy harnessed is non – radioactive and can be used to power our homes, industries and even our automobiles. When the equation is applied to cosmological bodies such as the Suns, Starts and others gives a better understanding of their origin.

12:09PM W10.00008 Rates of Charged Clocks in an Electric Field. MURAT OZER, None — The gravitational arguments leading to time dilation, redshift, and spacetime curvature are adapted to electric fields. The energy levels of two identical positively charged atoms at different potentials in a static electric field are shown to undergo blueshift. Secondly, the period of a charged simple pendulum (clock) in the electric field of a metallic sphere is shown to vary with the electric potential. The spacetime diagram for the world lines of two photons emitted and absorbed by two pendulums at different potentials in a static electric field are shown to undergo blueshift. Secondly, the period of a charged simple pendulum (clock) in the electric field of a metallic sphere is shown to vary with the electric potential. The spacetime diagram for the world lines of two photons emitted and absorbed by two pendulums at different potentials in a static electric field are shown to undergo blueshift. Secondly, the period of a charged simple pendulum (clock) in the electric field of a metallic sphere is shown to vary with the electric potential. The spacetime diagram for the world lines of two photons emitted and absorbed by two pendulums at different potentials in a static electric field are shown to undergo blueshift. Secondly, the period of a charged simple pendulum (clock) in the electric field of a metallic sphere is shown to vary with the electric potential. The spacetime diagram for the world lines of two photons emitted and absorbed by two pendulums at different potentials in a static electric field are shown to undergo blueshift.

12:21PM W10.00009 ABSTRACT WITHDRAWN –

Tuesday, April 15, 2008 10:45AM - 12:45PM – Session W11 DPF: Particle and String Theory Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis 8

10:45AM W11.00001 Heterotic Phenomenology of $SU(3)$ Manifolds. TIBRA ALI, GERALD CLEAVER, Baylor University — Incorporating the effects of flux compactifications, such as moduli fixing and supersymmetry breaking, in the $E_8 \times E_8$ heterotic string theory is an important problem both from the theoretical and phenomenological points of view. Since there is a dearth of fluxes in heterotic strings, one way of including fluxes is by considering the internal manifold to be a six dimensional $SU(3)$ manifold. In this talk we focus mainly on a subclass of $SU(3)$ manifolds known as half-flat manifolds.

First we consider the ten dimensional solution of the form $R^2 \times \mathbb{Z}_7$, where $R^2 \times \mathbb{Z}_7$ is a three dimensional Minkowski space-time and $\mathbb{Z}_7$ is a non-compact $G_2$ holonomy manifold. Half-flat manifolds can be thought of as hypersurfaces in $\mathbb{Z}_7$, and the above construction then implies that the four dimensional effective action that follows from compactification on a half-flat manifold breaks the $E_8 \times E_8$ group down to $E_6 \times E_6$, as in the standard embedding on Calabi-Yau compactifications. Recently, this result was also found by Gurrieri, Lukas and Micu independently using a different approach. In this talk we shall present aspects of the low-energy effective action emphasizing the ten dimensional geometric origin. We shall conclude by mentioning some observations about extending our methods and results to more general $SU(3)$ manifolds.
10:57AM W11.00002 Heterotic String Models with Perturbatively Broken Supersymmetry? , GERALD CLEAVER, Baylor University, ALON FARAGGI, ELISA MANNO, CRISTINA TIMIRGAZIU, University of Liverpool — By employing our standard analysis of flat directions we present a quasi-realistic three generation free fermionic heterotic string model in which an F- and D- flat solution does not appear to exist at least to eighth order in the superpotential. Our analysis suggests that stringent flat directions may not exist to any order. Bose-Fermi degeneracy of the string spectrum implies that the one-loop partition function and hence the one-loop cosmological constant vanishes in the model. Hence this model may represent the first known example with vanishing cosmological constant and perturbatively broken supersymmetry. We discuss the distinctive properties of the internal free fermion boundary conditions that may correspond to a large set of models that share these properties.

11:09AM W11.00003 Abelian fibrations, string junctions and type IIA duals of $T^6/\mathbb{Z}_2$, MICHAEL SCHULZ, Bryn Mawr College, RON DONAGI, University of Pennsylvania, PENG CAO, University of Toronto — In previous work, it was argued that the type IIB $T^6/\mathbb{Z}_2$ orientifold with a choice of flux preserving $N = 2$ supersymmetry is dual to a class of purely geometric type IIA compactifications on abelian surface ($T^4$) fibered Calabi-Yau manifolds. In this talk, I provide two concrete descriptions of the resulting manifolds. The first is a monodromy based description, which generalizes the F-theory technology of 7-branes and string junctions to the case of a $T^4$ rather than $T^2$ fiber. The second is an explicit algebra-geometric construction which the $T^4$ fibers arise as the Jacobian tori of a family of genus-2 Riemann surfaces. After describing some applications of this work, I close with a speculation on a relation between the latter construction and the dimensional duality of Silverstein et al.

11:21AM W11.00004 Physics and Geometry of Brane Vectors1, CHI XIONG, Postdoc Research Associate, Purdue, TOM CLARK, SHERWIN LOVE, Professor, Purdue, TONNIS TER VELDHUIS, Professor, Macalester — In the flexible brane world scenario we use the decomposition of higher dimensional gravity and Kaluza-Klein theories to explore the properties of extra vectors. These vectors were components of higher dimensional metric and are massive due to a Higgs effect which makes the Nambu Goldstone bosons become the longitudinal component of the vector fields. We study the masses of these vectors and their couplings to the Standard Model, by using the embedding geometry. In 5D spacetime we found that the geometry of the brane-bulk world, either intrinsic or extrinsic, depend on the extra vector and the 4D graviton only. Connections between the embedding geometry and coset construction by non-linear realization are also discussed.

1 The work of TEC, STL and CX was supported in part by the U.S. Department of Energy under grant DE-FG02-91ER40681 (Task B).

11:33AM W11.00005 Bjorken flow from an AdS Schwarzschild black hole , JAMES ALSUP, GEORGE SIOPSIS, University of Tennessee — We consider a large black hole in asymptotically AdS spacetime of arbitrary dimension with a Minkowski boundary. By performing an appropriate slicing as we approach the boundary, we obtain via holographic renormalization a gauge theory fluid obeying Bjorken hydrodynamics in the limit of large longitudinal proper time. The metric we obtain reproduces to leading order the metric recently found as a direct solution of the Einstein equations in five dimensions. Our results are also in agreement with recent exact results in three dimensions.

11:45AM W11.00006 Quasi-normal modes of a black hole localized on a brane1, USAMA AL-BINNI, GEORGE SIOPSIS, University of Tennessee — Black holes residing on a brane are expected to be observed at the LHC pointing to the existence of large extra dimensions. Signatures include the spectrum of Hawking radiation and quasi-normal modes through the detection of decay products. We calculate analytically the quasi-normal modes of black holes at the LHC using the WKB approximation. Unlike previous calculations, where the tension of the brane was assumed to be negligible, we obtain analytic expressions which are valid for any value of the tension of the brane (low as well as high).

1 This work was supported in part by the Department of Energy under grant DE-FG05-91ER40627.

11:57AM W11.00007 Charged Black Hole in a Canonical Ensemble , ANDREW LUNDGREN, Cornell University — We consider the thermodynamics of a charged black hole enclosed in a cavity. The charge in the cavity and the temperature at the walls are fixed, yielding a canonical ensemble. We derive the phase structure and stability of the black hole equilibrium states. We compare our results to those of other work which uses asymptotically anti-deSitter boundary conditions to define the thermodynamics. The thermodynamic properties have extensive similarities which suggest that the idea of AdS holography is more dependent on the existence of the boundary than on the exact details of asymptotically AdS metrics.

12:09PM W11.00008 A Simple Model to Solve $\mu/B^0$ Problem in Gauge Mediation1, TAO LIU, CARLOS WAGNER, Enrico Fermi Institute, University of Chicago, HIGH ENERGY PHYSICS GROUP (THEORY) AT UCHICAGO TEAM — We provide a simple model to solve $\mu/B^0$ problem in gauge mediated NMSSM. In this model the messenger sector contains one pair $3 - \bar{3}$ and one pair $2 + \bar{2}$ messengers. These two messenger pairs couple to different gauge singlets which measure SUSY breaking in the hidden sector. Such a messenger sector naturally arises in many backgrounds. We illustrate that the electroweak scale can be stabilized and phenomenologically interesting mass spectrum of particles and superparticles can be generated in most of the perturbative (at GUT scale) $\lambda - \kappa$ parameter region. In particular, this conclusion applies to all low-, intermediate- and high-scale gauge-mediations.

1The research of T.L. is supported by a Fermi-McCormick Fellowship, and that of C.W. is supported by the US DOE, Div. of HEP, Contract DE-AC02-06CH11357.

12:21PM W11.00009 Chiral Lattice Gauge Theories and the Strong Coupling Dynamics of a Yukawa-Higgs Model with Ginsparg-Wilson Fermions1, JOEL GIEDT, Dept. of Physics, Rensselaer Polytechnic Institute, ERICH POPPITZ, Dept. of Physics, University of Toronto, Canada — The Yukawa-Higgs/Ginsparg-Wilson-fermion construction of chiral lattice gauge theories described in hep-lat/0605003 uses exact lattice chirality to decouple the massless chiral fermions from a mirror sector, whose strong dynamics is conjectured to give cutoff-scale mass to the mirror fermions without breaking the chiral gauge symmetry. In this talk, we report on our study of the mirror sector dynamics of a two-dimensional chiral gauge theory in the limit of strong Yukawa and vanishing gauge couplings, in which case it reduces to an $X^1$ model coupled to Ginsparg-Wilson fermions. For the mirror fermions to acquire cutoff-scale mass it is believed to be important that the $X^1$ model remain in its “high temperature” phase, where there is no algebraic ordering—a conjecture supported by the results of our work. We use analytic and Monte-Carlo methods with dynamical fermions to study the scalar and fermion susceptibilities, and the mirror fermion spectrum. Our results provide convincing evidence that the strong dynamics does not “break” the chiral symmetry (more precisely, that the mirror fermions do not induce algebraic ordering in two-dimensions), and that the mirror fermions decouple from the infrared physics.

1 JG was supported in part by the Department of Energy grant DE-FG02-94ER40823 at the University of Minnesota. EP is supported by the National Science and Engineering Research Council of Canada.
12:33PM W11.00010 Symmetries in Evolving Space Time, and Their Connection to High Frequency Gravity Wave Production. ANDREW BECKWITH, APS/ Contractor, Fermi laboratory — We claim that linking a shrinking prior universe via a wormhole solution for a pseudo time dependent Wheeler DeWitt equation permits the formation of a short-term quintessence scalar field, which is tied to an initial configuration of the Einstein field equations allowing for high frequency gravitational waves (HFGW) at the onset of inflation. This is due to symmetries in space time which enable the creation of high frequency gravitational waves. The wormhole thermal bridge between prior to present universe is of less than Planck’s time duration, yet has consequences up to our present cosmological era. It also leads to phase transition changes which form a template as to graviton production.

Tuesday, April 15, 2008 10:45AM - 12:33PM –
Session W12 DPF: D and B Physics Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis C

10:45AM W12.00001 Study of \(D \to K/\pi e\nu_e\) and measurement of \(|V_{cs}|\) and \(|V_{cd}|\). BO XIN, Purdue University, CLEO COLLABORATION — Using a 281 pb\(^{-1}\) data sample comprised of 1.8 million \(DD\) mesons collected at the \(\psi(3770)\) with the CLEO-c detector, we measure absolute branching fractions as a function of \(q^2\), the invariant mass of the \(e^+\nu_e\) pair, for \(D^0 \to K^-e^+\nu_e\), \(D^0 \to \pi^-e^+\nu_e\), \(D^+ \to K^0_S e^+\nu_e\) and \(D^+ \to \pi^0 e^+\nu_e\). We measure the absolute magnitudes of the form factors \(f_\pm(0)\) and \(f_\mp(0)\). Using unquenched lattice QCD calculations of the form factor normalizations we extract the magnitudes of the CKM matrix elements \(V_{cs}\) and \(V_{cd}\). Our measurement of \(|V_{cs}|\) is the most precise direct determination to date. An extension of the analysis with the \(\approx 800\) pb\(^{-1}\) complete data set is also discussed.

10:57AM W12.00002 Search for CP violation in \(D^\pm\to K^\pm K^\mp\pi^\pm\). RYAN WHITE, University of South Carolina, BABAR COLLABORATION — We present a search for the direct CP asymmetry in the singly Cabibbo- suppressed decays \(D^\pm\to K^\mp K^\pm\pi^\pm\) based on a data sample of 468 fb\(^{-1}\) recorded by the BaBar detector. We report on the results of a simultaneous fit of the \(D^+\) and \(D^-\) Dalitz plots to measure the asymmetry in the resonant and non-resonant components.

11:09AM W12.00003 Model-Independent Partial-Wave Analysis of \(D^+ \to K^-\pi^+\pi^+\). KAZUHIITO SUZUKI, Stanford Linear Accelerator Center, BABAR COLLABORATION — We report a preliminary result of a model-independent partial-wave analysis of the \(D^+ \to K^-\pi^+\pi^+\) decay. The decay provides a good sample to improve our knowledge of the partial-wavelength structures in the \(K\pi\) system from such decays. The analysis is performed using data collected by the BaBar detector at the PEPII asymmetric-energy \(e^+e^-\) storage rings at SLAC. A high-statistics sample enables us to perform the analysis without employing theoretical models in the \(s^-\) and \(P^-\) wave parameterizations. The result may provide a useful application in heavy-flavor physics.

11:21AM W12.00004 Measurement of the \(D^0 \to \phi\eta\) Branching Fraction. KEVIN COBURN, Ohio State University, BABAR COLLABORATION — We present a preliminary result for branching fraction measurement of the decay \(D^0 \to \phi\eta\) where \(D^0\) comes from the decay \(D^{+}\to D^{0}\pi^{+}\). We use a high statistics data sample collected with the BaBar detector at the PEPII asymmetric \(e^+e^-\) colliders at SLAC.

11:33AM W12.00005 Study of \(B\) meson decays to \(\eta K\gamma\) final states. PIETRO BIASSONI, INFN Sezione di Milano, BABAR COLLABORATION — We present measurements of the branching fraction and integrated CP asymmetry for charged \(B\) meson decays to \(\eta K\gamma\), and the branching fraction and time-dependent CP asymmetry for neutral \(B\) meson decays to \(\eta K^{0}\gamma\). Our measurements are based on data collected from 1999-2007 with the BaBar detector at the PEPII asymmetric-energy \(e^+e^-\) collider at SLAC.

11:45AM W12.00006 A Measurement of the Direct CP Asymmetry in the Decay \(b \to s\gamma\). MINLIANG ZHAO, Massachusetts Institute of Technology, BABAR COLLABORATION — We present a measurement of the direct CP asymmetry in the rare Standard Model decay \(b \to s\gamma\) using 380 million \(BB\) events collected by the BaBar experiment at the PEPII \(B\)-factory. In the Standard Model, direct CP violation in this process is expected to be \(< 1\%\), while in new physics models (such as the Minimal Supersymmetric Standard Model) it can be as high as \(15\%\). We select this rare decay by fully reconstructing the \(B\) meson decay into a fragmented \(s\)-quark and a photon using many exclusive final states of the \(s\)-factory.

11:57AM W12.00007 Time-dependent analysis of \(B^0 \to \rho^0\rho^0\) decays. LOIC ESTEVE, Centre d’Etudes Nuclaires, Saclay, BABAR COLLABORATION — We study the decay \(B^0 \to \rho^0\rho^0\) in a sample of about 454 million \(\Upsilon(4S)\to BB\) decays collected with the BaBar detector at the PEPII asymmetric-energy \(e^+e^-\) collider at SLAC. We measure the branching fraction and longitudinal polarization fraction. We investigate the proper-time dependence of the longitudinal component in the decay and measure the CP-violating coefficients \(S^{\rho\rho}_{10}\) and \(C^{\rho\rho}_{10}\) corresponding to the sine and cosine terms in the time evolution of the CP asymmetry. We study the implication of these results for the CKM unitarity angle \(\alpha\).

12:09PM W12.00008 Measurement of branching ratios for two-pion transitions in the bottomonium system. KRIS KLEIN, Luther College, CLEO COLLABORATION — Using approximately 9 million \(\Upsilon(2S)\) decays and 6 million \(\Upsilon(3S)\) decays, the CLEO Collaboration has made new measurements of the branching ratios for charged (via \(\pi^+\pi^-\)) and neutral (via \(\pi^0\pi^0\)) transitions among the three lowest-lying \(\Upsilon(\nu S)\) states.

12:21PM W12.00009 Measurement of \(\gamma\) using a \(D\) Dalitz analysis of \(B^{\pm} \to D^{(*)}K^{(*)}\pm\) decays. NEUS LOPEZ-MARCH, IFIC, Universitat de Valencia-CSIC, BABAR COLLABORATION — We report on an improved measurement of the Cabibbo-Kobayashi-Maskawa CP-violating phase \(\gamma\) through a Dalitz analysis of neutral \(D\) decays to \(K^0_S\pi^0\) and \(K^0_S K^+K^-\) in the processes \(B^{\mp} \to DK^\mp, B^+ \to D^*K^\mp\) with \(D^+ \to D\pi^0, D\gamma,\) and \(B^+ \to D K^+\Sigma^+\) with \(K^{*\pm} \to K^0_S \pi^\pm\). The analysis is based on a sample of 383 million \(BB\) pairs collected by the BaBar detector at the PEPII asymmetric-energy \(e^+e^-\) collider at SLAC.

Tuesday, April 15, 2008 10:45AM - 12:21PM –
Session W13 DNP: Neutrinos III Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis F
10:45AM W13.00001 Deconstruction of atmospheric neutrino oscillation data, DAVID ERNST, JESUS ESCAMILLA, Vanderbilt University, DAVID LATIMER, University of Kentucky — Atmospheric neutrinos are statistically the most important subset of neutrino oscillation data and they cover a range of L/E values that span four orders of magnitude. However, atmospheric data is the most complex to analyze because the source is neutrinos produced in the atmosphere by cosmic rays and because this data is the only data which measures the direction of the created lepton. We examine bin by bin the average and rms values of the physics parameters associated with each bin and thus ascribe the importance of each bin for determining the oscillation parameters, including theta_13.

10:57AM W13.00002 Neutrino-anti-neutrino analysis of atmospheric data, JESUS ESCAMILLA, Vanderbilt University, DAVID LATIMER, University of Kentucky, DAVID ERNST, Vanderbilt University — To date all atmospheric neutrino oscillation data does not discriminate between neutrinos and anti-neutrinos. We investigate the possibility of performing an analysis using realistic hypothetical data that distinguishes neutrinos from anti-neutrinos. This allows us to examine in more detail the role of the MSW effect and CP violation. This will provide guidance for future possible experiments.

1Membership Pending

11:09AM W13.00003 Neutrinos from a black hole-neutron star merger, REBECCA SURMAN, Union College, GAIL MCLAUGHLIN, North Carolina State University — A possible progenitor of short-duration gamma-ray bursts is the merger of a black hole and a neutron star in a binary system. The collision is thought to form a black hole surrounded by a rapidly accreting disk of debris. This accretion disk powers the burst, and its outflows are likely the site of interesting nucleosynthesis. If such a merger were to happen in our galaxy, the neutrinos from the accretion disk would be detectable on Earth. Here we examine the role of neutrinos in the black hole-neutron star merger scenario. We begin with the results of a three dimensional numerical model of a black hole-neutron star merger and calculate the neutrino and antineutrino fluxes emitted from the resulting accretion disk. We then discuss the impact of the neutrinos on the system, focusing on their influence on the outflow nucleosynthesis.

1Supported by the DOE

11:21AM W13.00004 Magnetic Moment of Massive Neutrinos in Thermal Background, SAMINA MASOOD, Univ. of Houston Clear Lake — We compare the magnetic moment of neutrinos carrying different type of mass in hot and dense media. The background effects on the magnetic moment of neutrinos are shown to depend on the type of neutrino mass. We compare the magnetic moment for the same value of temperature and density for Dirac and Majorana type of neutrino. Background effects are shown to be more important in the very early universe.

11:33AM W13.00005 ABSTRACT WITHDRAWN

11:45AM W13.00006 ABSTRACT WITHDRAWN

11:57AM W13.00007 ABSTRACT WITHDRAWN

12:09PM W13.00008 ABSTRACT WITHDRAWN

Tuesday, April 15, 2008 10:45AM - 12:33PM
Session W14 DNP: Applications of Nuclear Physics and Nuclear Techniques
Hyatt Regency St. Louis Riverfront (formerly Adam039:s Mark Hotel), St. Louis G

10:45AM W14.00001 New neutron capabilities for the Berkeley Accelerator Space Effects (BASE) Facility at the 88-Inch Cyclotron at LBNL, MARGARET McMahan, C.C. Jewett, Lawrence Berkeley National Lab — The Berkeley Accelerator Space Effects (BASE) Facility provides heavy ions and protons for radiation effects testing by government laboratories (Defense, Energy and NASA) and contractors, private U.S. companies and international companies and laboratories. The combination of state-of-the-art ion sources for heavy ion running and relatively high intensities (up to 10 microamps) for protons makes it a very versatile 'one-stop-shop' for the radiation testing community. To add to this capability, a fast neutron capability has been developed using the d(Be,n) reaction in stopping targets. The choice of deuterium energy, ranging from 5 to 65 MeV, gives a broad energy spectra with some tunability. The commissioning of this facility will be discussed including energy and flux measurements, dosimetry and initial experiments. In the future, two off-line neutron generators will also be in operation at the BASE facility, providing thermal neutrons as well as monoenergetic neutrons at 2.5 and 14 MeV. These sources, running independently of the Cyclotron, will complement the broad spectra neutrons at higher energies, providing a unique and versatile neutron capability.

1Supported by the U.S. Department of Energy under Contract No. DE-AC02-05CH11231

10:57AM W14.00002 Benchmarking Radiation Transport Codes for Space Missions, RAM TRIPATHI, NASA Langley Research Center, Hampton, VA, JOHN WILSON, NASA Langley Research Center, LARRY TOWNSEND, University of Tennessee, TONY GABRIEL, SID, Knoxville, TN, LARRY PINSKY, University of Houston, TONY SLABA, Old Dominion University — For long duration and/or deep space human missions, protection from severe space radiation exposure is a challenging design constraint and may be a potential limiting factor. The space radiation environment consists of galactic cosmic rays (GCR), solar particle events (SPE), trapped radiation, and includes ions of all the known elements over a very broad energy range. These ions penetrate spacecraft materials producing nuclear fragments and secondary particles that damage biological tissues, microelectronic devices, and materials. Accurate risk assessments critically depend on the accuracy of the input information about the interaction of ions with materials, electronics and tissues and the radiation transport codes. Due to complexity of the problem and paucity of huge amount of experimental data, it is prudent to benchmark leading radiation transport codes to build increasing confidence in exposure estimates. The deterministic code HZETRN2006, and the Monte Carlo Codes HETC-HEDS and FLUKA, are used for benchmarking efforts. The SPE Webber spectrum and 1977 GCR radiation environments has been taken to make radiation dose exposure studies on aluminum shield followed by water target.
11:09AM W14.00003 Investigation of the use of high-pressure xenon detectors in ion beam analysis.

ARTHUR K. PALLONE, Murray State University, JOHN DEREK DEMAREE, U.S. Army Research Laboratory, AL BEYERLE, Mirmar Sensor — Ion beam analysis (IBA) provides nondestructive compositional information. Three major requirements for detectors used in IBA are high efficiency, high resolution, and high signal to noise ratio (SNR). The standard detector used in γ-photon based IBA techniques is the thallium-doped sodium iodide (NaI(Tl)) – scintillator. High-pressure xenon detectors (HPXe) present certain advantages over NaI(Tl) and other detector types for IBA conditions. The performance of a 1.5-inch diameter by 3-inch long high-pressure xenon (HPXe) detector is investigated at energies useful to IBA. The performance is compared to theoretical predictions. Recommendations are then made for a physically larger HPXe system for IBA.

11:21AM W14.00004 Neutron-Induced Partial Gamma-Ray Cross-Section Measurements on Uranium at TUNL

A. HUTCHESON, ASON CROWELL, B. FALLIN, C.R. HOWELL, M. KISER, E. KWAN, A.P. TONCHEV, W. TORNOW, Duke University/TUNL, J.H. KELLEY, North Carolina State University/TUNL, C.T. ANGELL, H.J. KARWOWSKI, University of North Carolina/TUNL, R.S. PEDRONI, North Carolina A&T, G.J. WEISEL, Penn State Altoona, J.A. BECKER, D. DASHDORJ, R.A. MACRI, Lawrence Livermore National Laboratory, N. PEDRONI, D.O. NELSON, Los Alamos National Laboratory. — Precision measurements of (n,n') and (n,2n) reaction cross sections have been performed on 235,237U targets at Trinity Universities Nuclear Laboratory using a pulsed and mono-energetic neutron beam. The excitation function has been studied with incident neutron energies between 5 and 14 MeV and beam flux of 10^11 n s^-1 cm^-2 at target position. Multiple partial cross sections have been determined observing gamma rays in clover and planar HPGe detectors. The results will be compared with calculations using Hauser-Feshbach model.

11:33AM W14.00005 Measurement of Delayed Neutron Production in a Tungsten Spallation Neutron Target

ROBERT MAHURIN, GEOFFREY GREENE, University of Tennessee, JAREK MAJEWSKI, HILLARY SMITH, W. SCOTT WILBURN, Los Alamos National Laboratory, DAVID BOWMAN, SEPPO PENNTILA, Oak Ridge National Laboratory, LIBERTAD BARRON, Arizona State University, W. MICHAEL SNOW, Indiana University — We use neutron reflectometry to determine the contribution of delayed neutrons to the spallation spectrum at the Manuel Lujan Jr. Neutron Scattering Center at the Los Alamos National Laboratory. The delayed neutron fraction is 1.1(1) x 10^-4 in conformance with rough theoretical expectations. Within the accuracy of the measurement, the delayed neutrons have the same spectrum as the prompt neutrons and display no time structure on the order of ~100 ms. While this measurement describes the delayed neutron production from a Tungsten spallation neutron target, it provides guidance for the expected delayed neutron production in other targets including the Mercury target at the Oak Ridge National Laboratory Spallation Neutron Source.

11:45AM W14.00006 Modification of apparent fission yields by Chemical Fractionation following Fission

CHARLES HOHENBERG, ALEX MESHIK, Washington Univ. — Grain-by-grain studies of the 2 billion year old Oklo natural reactor, using laser micro-extraction, yield detailed information about Oklo, a water-moderated pulsed reactor, cycle times, total neutron fluence and duration, but it also demonstrates Chemical Fractionation following Fission. In the CFF process, members of an isobaric yield chain with long half-lives are subject to migration before decay can occur. Of particular interest is the 129 isobar where 17 million 129I can migrate out of the host grain before decay, and iodine compounds are water soluble. This is amply demonstrated by the variation of Xe spectra between micron-sized uranium-bearing minerals and adjacent uranium-free minerals. Fission 129 yields for the spontaneous fission of 235U generally come from measured 129Xe in pitchblende, ores emplaced by aqueous activity, and are incorrect due to the CFF process. 129Xe yields for the 131 and 129 chains, reported in Hyde, are 0.455 ± 0.02 and < 0.012, respectively, the latter being anomalously low. A. MESHIK, C. HOHENBERG and O. PRAVDIVTEVA, PRL 93, 182302 (2004); A MESHIK Sci. Am. Nov (2005), 55; E K HYDE, Nucl Prop of Heavy Elements III (1964).

11:57AM W14.00007 Fission xenon in trinitites from the first nuclear test

ALEXANDER MESHIK, OLGA PRAVDIVTEVA, CHARLES HOHENBERG, Washington Univ. — Trinitites, greenish glassy remnants found in the crater of the first nuclear test, refer to the molten material of the desert where the Trinity test was conducted. Recently the Los Alamos Lab suggested that the sand was first vaporized by the fireball and then precipitated onto a cooler desert surface forming trinitites. We measured the Xe mass-spectra during stepped pyrolysis of two trinitites and found an unusual Xe isotopic structure, dominated by 131Xe and 133Xe compared to the nominal fission yield spectra, which cannot be due to n-capture or any other nuclear processes. This structure is caused by the chemical separation of the immediate neutron-rich fission products, a process similar to CFF observed in the Oklo natural reactor. When quantitatively applied to our observations it suggests that 17 min after the test one of the samples had a temperature of 1390°C, while 5 min after the test the other was at 1320°C. These results contribute to a reconstruction of the cooling history of the trinitites and a demonstration of which formation scenario is the more likely. V. Montoya et al, Denver X-ray Conf. (2007); A. MESHIK, C. HOHENBERG and O. PRAVDIVTEVA, PRL 93, 182302 (2004).

12:09PM W14.00008 The three photon yield from e+ annihilation in biological liquids

R. LAFOREST, Washington University School of Medicine, K. MERCURIO, Department of Physics, Washington University, P. ZERKEL, Washington University School of Medicine, L.G. SOBOTKA, Departments of Chemistry and Physics, Washington University, R.J. CHARITY, Department of Chemistry, Washington University — Positrons annihilate either by the emission of 2-511 keV photons or 3-photons (from the decay of positronium in the triplet state.) The fraction of the 3-photon decay depends on the chemical environment and notably on the concentration of O2. Consequently, 3-photon event detection has been proposed as a mean to measure hypoxia, a condition prevailing in cancer. The (delayed) three-photon yield in various fluids, at both high and low O2 levels, has been extracted by fitting the time dependence of the two-photon yield to a set of coupled differential equations. The differential equations, in a simple and satisfactory fashion account for the e+ capture to form positronium and the decay and interconversion of the two forms. The total fraction of three photon events (both direct and delayed), which could be used for event-by-event position localization in PET-like imaging, is estimated to be ~ 0.5 % with the measured (from our work) delayed component of no more than 0.25 % (in water-like vessels). There is no (or an exceedingly small) dependence on the dissolved oxygen content in aqueous solutions.

12:21PM W14.00009 A Neutron Scattering Kernel of Solid Methane in phase II

YUNCHANG SHIN, WILLIAM MICHAEL SNOW, CNEN-YU LIU, CHRISTOPHER M. LAVELLE, DAVID V. BAXTER — A neutron scattering cross section model of solid methane was studied for the cold neutron moderator of Low Energy Neutron Source (LENS) at IUCF/Indiana University especially in temperature range of 20.4 K. The analytical scattering kernel was adapted from Ozaki.et al. to describe molecular rotation in this temperature range. This model includes a molecular anisotropy parameter which was studied for the cold neutron moderator of Low Energy Neutron Source (LENS) at IUCF/Indiana University especially in temperature range of 20.4 K. The analytical scattering kernel was adapted from Ozaki.et al. to describe molecular rotation in this temperature range. This model includes a molecular anisotropy parameter which was studied for the cold neutron moderator of Low Energy Neutron Source (LENS) at IUCF/Indiana University especially in temperature range of 20.4 K. The analytical scattering kernel was adapted from Ozaki.et al. to describe molecular rotation in this temperature range. This model includes a molecular anisotropy parameter which was studied for the cold neutron moderator of Low Energy Neutron Source (LENS) at IUCF/Indiana University especially in temperature range of 20.4 K. The analytical scattering kernel was adapted from Ozaki.et al. to describe molecular rotation in this temperature range. This model includes a molecular anisotropy parameter which was studied for the cold neutron moderator of Low Energy Neutron Source (LENS) at IUCF/Indiana University especially in temperature range of 20.4 K. The analytical scattering kernel was adapted from Ozaki.et al. to describe molecular rotation in this temperature range. This model includes a molecular anisotropy parameter which was studied for the cold neutron moderator of Low Energy Neutron Source (LENS) at IUCF/Indiana University especially in temperature range of 20.4 K. The analytical scattering kernel was adapted from Ozaki.et al. to describe molecular rotation in this temperature range. This model includes a molecular anisotropy parameter which was studied for the cold neutron moderator of Low Energy Neutron Source (LENS) at IUCF/Indiana University especially in temperature range of 20.4 K. The analytical scattering kernel was adapted from Ozaki.et al. to describe molecular rotation in this temperature range. This model includes a molecular anisotropy parameter which was studied for the cold neutron moderator of Low Energy Neutron Source (LENS) at IUCF/Indiana University especially in temperature range of 20.4 K. The analytical scattering kernel was adapted from Ozaki.et al. to describe molecular rotation in this temperature range. This model includes a molecular anisotropy parameter which was studied for the cold neutron moderator of Low Energy Neutron Source (LENS) at IUCF/Indiana University especially in temperature range of 20.4 K. The analytical scattering kernel was adapted from Ozaki.et al. to describe molecular rotation in this temperature range. This model includes a molecular anisotropy parameter which was studied for the cold neutron moderator of Low Energy Neutron Source (LENS) at IUCF/Indiana University especially in temperature range of 20.4 K.


B-factory experiments have discovered a series of charmonium-like mesons, including the \( \Lambda(1405) \) of the parity of the \( \eta \) from the GeV longitudinally polarized electron beam impinging on a liquid Hydrogen target. In this presentation, the results of the beam spin asymmetry measurements which is a part of the analysis for e1-dvcs experiment. This experiment was run at Jefferson Lab during the spring of 2005 with the CLAS detector, using a 5.7 \( \text{GeV} \) electron beam at Jefferson Laboratory and the well established HKS spectrometer system for hypernuclear spectroscopy opens new opportunity for a high precision decay pion spectroscopy program. The decay pion contains information that offers wide range of hypernuclear and nuclear physics, from precise determination of binding energy of the ground state of light hypernuclei to study YN interaction, investigation of highly exotic hypernuclei to study mechanism for exotic nuclei, to probing the detailed low lying nuclear structure with the nuclear “impurity” –insertion of a \( \Lambda \) into the nucleus. Combination of the CEBAF beam (electron-production of hypernuclei) and the HKS system makes the program capable to reach a high energy resolution of \( \sigma \sim 55 \text{ keV} \) thus rich physics can be learned from the decay pions from two body mesonic hypernuclear decay. The physics and experimental technique will be presented.

11:09AM W15.00003 Beam Spin Asymmetry Measurements from Deeply Virtual Meson Production, BO ZHAO, RITA DE MASI, MICHEL GARCÓN, KYUNGSEON JOO, VALERY KUBAROVSKY, PAUL STOLER, MAURIZIO UNGARO, CLAS COLLABORATION — The unique beam parameters (high intensity, small emittance, and fine beam bunch time structure) of the CW electron beam at Jefferson Laboratory and the well established HKS spectrometer system for hypernuclear spectroscopy opens new opportunity for a high precision decay pion spectroscopy program. The decay pion contains information that offers wide range of hypernuclear and nuclear physics, from precise determination of binding energy of the ground state of light hypernuclei to study YN interaction, investigation of highly exotic hypernuclei to study mechanism for exotic nuclei, to probing the detailed low lying nuclear structure with the nuclear “impurity” –insertion of a \( \Lambda \) into the nucleus. Combination of the CEBAF beam (electron-production of hypernuclei) and the HKS system makes the program capable to reach a high energy resolution of \( \sigma \sim 55 \text{ keV} \) thus rich physics can be learned from the decay pions from two body mesonic hypernuclear decay. The physics and experimental technique will be presented.

11:21AM W15.00004 Quark Dressing and Constituent Mass Behavior for Heavy Quark Mesons\(^1\), NICHOLAS SOUCHLAS, Kent State University, PIETER MARIS, Iowa State University, PETER TANDY, Kent State University — We explore the effects of quark dressing upon the masses and electroweak decay constants of ground state pseudoscalar and vector quarkonia and heavy-light mesons. Quark masses are varied from the u/d region to the b-quark region. The effectiveness of a constituent mass approximation is evaluated. Residual effects of dressing are clearly evident in the values of the decay constants in the c- and b-quark regions. This fully covariant study is made with a consistent ladder-rainbow truncation for the Bethe-Salpeter and Dyson-Schwinger equations.

\(^1\)Work supported in part by NSF grant No. PHY-0610129.

11:33AM W15.00005 Parity Determination of the \( \Lambda(1405) \), KEI MORIYA, REINHARD SCHUMACHER, Carnegie Mellon University, CLAS COLLABORATION — The \( \Lambda(1405) \) is a well-established hyperon state just below N \( \bar{K} \) threshold. Previous studies of its spin and parity have been inconclusive, but consistent with \( J = 1/2 \). Using the CLAS system at Jefferson Lab, we collected an event sample of \( \sim 1.8 \times 10^9 \) reconstructed \( \Lambda(1405) \) hyperons photoproduced off the proton, with photon energies between 1.5 and 3.9 GeV. We present preliminary results of the first definitive measurement of the parity of the \( \Lambda(1405) \) using the method of Byers and Fenster. The method relies on our observation that the \( \Lambda(1405) \) is produced polarized in this reaction. Determination of the polarization axis of the \( \Sigma^+ \) hyperon from the decay of a \( J = 1/2 \) \( \Lambda(1405) \) to \( \Sigma^+ \pi^- \) then reveals the parity of the parent state.

11:45AM W15.00006 Line Shapes of Exotic \( c \bar{c} \) Mesons\(^1\), MENG LU, ERIC BRAATEN, Ohio State University — The B-factory experiments have discovered a series of charmonium-like mesons, including the \( X(3872) \) and the first manifestly exotic meson \( Z^+ (4430) \). The proximity of the masses of these two mesons to thresholds for pairs of charm mesons has motivated their interpretations as charm meson molecules. Given these interpretations, we investigate the invariant mass distributions (line shapes) of \( X(3872) \) and \( Z^+ (4430) \) by taking advantage of the universality of \( S \)-wave bound states with small binding energies and by including the effects from the nonzero widths of their constituents. We isolate the dependence of the line shapes on the details of QCD into constant factors. We make quantitative predictions of the line shapes for the \( X(3872) \) and the \( Z^+ (4430) \) with an emphasis on the difference between the line shapes in decay modes containing a charmonium and those containing two charm mesons.

\(^1\)This research was supported in part by the Department of Energy under grant DE-FG02-91-ER40690.

11:57AM W15.00007 Estimate of \( \langle \bar{q}q\bar{q}q \rangle \) from the V-A Current-Current Correlator\(^1\), TRANG NGUYEN, PETER TANDY, Kent State University — In QCD, the difference of the current-current correlators for vector and axial vector currents, in a color singlet and flavor non-singlet channel, is zero to all orders in perturbation theory if the quarks are massless. As an example of the efficiency of this so-called V-A correlator in probing nonperturbative phenomena, its leading ultraviolet term is proportional to the scalar 4-quark condensate \( \langle \bar{q}q\bar{q}q \rangle \). This condensate is a key ingredient in QCD sum rule analyses of hadronic properties and, in the absence of independent information, it is often assumed that vacuum saturation holds, namely \( \langle \bar{q}q\bar{q}q \rangle \approx \langle qq \rangle \). We describe here an independent estimate based upon direct evaluation of the current-current correlators within a ladder-rainbow truncated model of QCD. Our results indicate that \( \langle \bar{q}q\bar{q}q \rangle \) is significantly larger than what vacuum saturation would suggest.

\(^1\)Work supported in part by NSF grant No. PHY-0610129.
**12:09PM W15.00008 Strangeness Production on the Neutron in the Deuteron with Polarized Photons:** $\vec{\gamma}n \rightarrow K^+\Sigma^-$, EDWIN MUNEVAR, BARRY BERMAN, The George Washington University, THE CLAS COLLABORATION — As in the case of atomic systems, the measurement of the excited spectrum of nucleons provides valuable information about their internal composition. The study of the extra excited states of the nucleon (missing resonances) predicted by the constituent quark model but not found experimentally are key in the understanding of the nucleon structure. The experimental search for these missing states is believed to be more effective using strangeness channels because they offer the possibility of determining several spin observables. A recent experiment done using the CLAS system at JLab, based on a liquid deuterium target and a polarized photon beam covering from threshold to 2.5 GeV provides high-quality data (about 52 billion triggers) in strangeness production on the neutron. These neutron channels are important for constraining phenomenological models. A brief description of this experiment along with a very preliminary analysis for the $\vec{\gamma}n \rightarrow K^+\Sigma^-$ reaction will be presented.

**Tuesday, April 15, 2008 10:45AM - 12:21PM**

Session W16 FEd: Physics Education II Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Director039;s Row 29

**10:45AM W16.00001 Understanding the Gender Gap in Introductory Physics**, NOAH FINKELSTEIN, University of Colorado at Boulder, LAUREN KOST, STEVEN POLLOCK, University of Colorado — While it has been suggested interactive engagement (IE) techniques can eliminate the gender gap (the difference in performance between men and women on measures of conceptual learning), we find that, at our institution, the gender gap persisted from pre to posttest in IE classes (Pollock, Physical Review: ST PER. 3, 010107, 2007). This talk reports on a three-part follow-up study that investigates what factors contribute to the gender gap. First, we analyze student grades in different components of the course and find that men and women’s course grades are not significantly different ($p>0.1$), but men outscore women on exams and women outscore men on homework and participation. Second, we compare average posttest scores of men and women who score similarly on the pretest and find that there are no significant differences between men and women’s average posttest scores. Finally, we analyze other factors in addition to the pretest score that could influence the posttest score and find that gender does not account for a major portion of the variation in posttest scores when a measure of mathematics performance is included. These findings indicate that the gender gap exists in interactive physics classes, but may be due in large part to differences in preparation, background, and math skills as assessed by traditional survey instruments.

$^1$With support from the NSF.

**10:57AM W16.00002 Why Don’t More Women and Minorities Study Undergraduate Physics? A Case Study**, HILLARY SMITH, Los Alamos National Laboratory, DEREK WEISEL, Los Alamos School District — It has often been suggested that the lack of women and ethnic minorities studying physics in college can be traced back to the science and math education of students in high school and before. This talk presents data from a two-part survey of high school science students. First, students were asked what subjects they enjoy and their perceived level of competency in math and science. Second, students were asked their plans for secondary education and what factors contributed to this decision. The results have been correlated to gender and ethnicity. Analysis of the results indicates trends along gender and ethnic lines in what students believe they are good at, what they enjoy studying, in what ways they plan to continue their education, and what they plan to study in college.

**11:09AM W16.00003 Can Scientific Reasoning Ability and Epistemological Beliefs Limit Success in Introductory Physics?**, BRIAN PYPER, LONDON JENKS, MICHELLE KLINGLER, ALLISON SHAFFER, BYU-Idaho — Research in Physics Education is shedding new light on the relationship between scientific reasoning ability, epistemological beliefs, and conceptual change in Introductory Physics. This talk will present data acquired from several courses at BYU-Idaho in an ongoing effort to improve conceptual understanding among introductory Physics and Physical Science students.

**11:21AM W16.00004 Quantitative rubber sheet models of gravitation wells using Spandex**, GARY WHITE, American Institute of Physics/Society of Physics Students — Long a staple of introductory treatments of general relativity, the rubber sheet model exhibits Wheeler’s concise summary—“Matter tells space-time how to curve and space-time tells matter how to move”—very nicely. But what of the quantitative aspects of the rubber sheet model: how far can the analogy be pushed? We show that when a mass $M$ is suspended from the center of an otherwise unstretched elastic sheet affixed to a circular boundary it exhibits a distortion far from the center given by $h = A^*(M*r^2)^{1/3}$. Here, as might be expected, $h$ and $r$ are the vertical and axial distances from the center, but this result is not the expected logarithmic form of 2-D solutions to Laplace’s equation (the stretched drumhead). This surprise has a natural explanation and is confirmed experimentally with Spandex as the medium, and its consequences for general rubber sheet models are pursued.

$^1$—The shape of ‘the Spandex’ and orbits upon its surface. American Journal of Physics, 70, 48-52 (2002), G. D. White and M. Walker. See also the comment by Don S. Lemons and T. C. Lipcombe, also in AJP, 70, 1056-1058 (2002).

**11:33AM W16.00005 Synchronizing Physics And Math Standards**, DEREK WEISEL, Los Alamos School District — State and national standards tend to focus primarily on math and reading. This has led many schools to focus the majority of instruction time on these two subjects. This creates the negative effect of placing less emphasis on physics in many schools. An effective way to keep physics as a primary focus in schools is to emphasize that physics curriculum meets many of the math standards and can be used as a tool to introduce, practice and reinforce important math concepts. This is also a way for physics curriculum to be introduced at the elementary level. This talk will highlight some common areas where math standards are being met and exceeded in the physics curriculum.

**11:45AM W16.00006 Improvement in High School physics Teaching will Increase Physics Enrollment**, SAMINA MASOOD, Univ. of Houston Clear Lake — We study the effect of better high school teaching on the physics enrollment. Adequate mathematics background, physics curriculum, teaching methodology and the teacher-student relationship contribute to attract students to study physics at the college level.
11:57AM W16.00007 Analysis of the Collapse of the South Tower of the World Trade Center

CROCKETT GRABBE, University of Iowa & SeaLane Consulting — An analysis of the South Tower collapse is made by examining the earlier stages of the collapse, with careful consideration given to the conservation of energy and momentum in the top segment of the tower. This includes events such as the upward movement of the corner of that top segment on collapse initiation, at the same time that squibs appear below the segment. Information gained on the details of that development is used to calculate the minimum energy and power of the sources of that collapse initiation, and it is shown that the sources of that energy and power include up to 2 separate sets of conventional explosives inside the building just below the top segment. It is shown these explosive forces must produce the energy- and momentum-impacting moves of that top segment, and result in the white clouds that are seen to arise from pulverized concrete below the the floors where the plane impacted, and the subsequent gray clouds that result from pulverized concrete (part of it black carbon produced by the fires) of the top segment. The development of the gray clouds is shown to result from the rapid disintegration of this top segment near its interface with the floors below the impact.

1 Supported by grant ATM0335583 with the National Science Foundation

12:09PM W16.00008 ABSTRACT WITHDRAWN

Tuesday, April 15, 2008 10:50AM - 2:50PM
Session 16HE HEDP HEDLA: Quark-Gluon Plasmas
Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), Promenade F

10:50AM 16HE.00001 Introduction to strongly coupled quark-gluon plasma
EDWARD SHURYAK, Stony Brook University — Quark-gluon plasma is a deconfined phase of QCD, at temperatures above \( T_c \approx 170 \text{ MeV} \). Analysis of RHIC experiments and also lattice data have shown that it is not just a weakly coupled gas of quarks and gluons, as anticipated at large \( T \). Strongly coupled plasmas can be studied via gauge-string duality known as AdS/CFT, which relates its properties to 5d black hole physics. I will mostly focus on another duality – electric-magnetic one. It was recently realized that QGP near \( T_c \) has significant fraction of (color)-magnetically charged quasiparticles – monopoles, and those Bose-condense below \( T_c \). Molecular dynamics for plasma made of both electrically and magnetically charged particles revealed unusual properties: one of them significant increase of collision rate and decrease of diffusion and viscosity. At the end of the talk, results for transport coefficients from AdS/CFT and MD will be compared to empirical ones from RHIC data.

11:15AM 16HE.00002 Instabilities in non-Abelian plasmas
STANISLAW MROWCZYNSKI, Institute for Nuclear Studies, Warsaw — Quark-gluon plasma, in spite of its non-Abelian dynamics, reveals some similarities to electromagnetic plasmas. In particular, there is a rich spectrum of instabilities which appear to be important to understand a fast equilibration of the quark-gluon plasma produced at the early stage of relativistic heavy-ion collisions. Experimental data suggest that such a plasma reaches equilibrium within 1 fm/c and inter-parton collisions seem to be “slow.” However, due to anisotropic momentum distribution, the parton system is unstable with respect to the chromo-magnetic plasma modes. These color instabilities, which are known in the electromagnetic plasmas as the Weibel instabilities, effectively isotropize the system and thus speed up the process of equilibration.

11:40AM 16HE.00003 Experimental study of properties of quark gluon plasma via heavy quarks and EM probes
YASUYUKI AKIBA, RIKEN — Experimental results have established that very dense partonic matter is formed in Au+Au collisions at RHIC. At such high density, it is believed that quarks and gluons are no longer confined in hadrons, but become constitutes of a quark-gluon plasma (QGP). Heavy quark bound state (J/Psi), heavy quarks (charm and bottom), and EM probes (photons and dileptons) are best probes of the properties of the dense matter formed at RHIC. The suppression of J/Psi can probe the strength of the color screening in the matter. Observation of large energy loss and flow of heavy quarks suggests that the viscosity to the entropy ratio of the matter is close to its quantum lower bound. Production of photons and dileptons provide information deep inside of the matter. I will review recent experimental results of these measurements.

12:05PM 16HE.00004 Experimental study of collective motion in the quark gluon plasma
SHINICHI ESUMI, Univ. of Tsukuba, Inst. of Physics — Collective phenomena have been studied to investigate a property of Quark Gluon Plasma in high-energy heavy-ion collisions at AGS, SPS and RHIC experiments. Whether the origin of elliptic and/or radial collective expansions is given in a partonic or a hadronic phase is a key question for the experimental observables to be sensitive to the QGP or not. The number of quark scaling in the observed elliptic flow parameter \( v_2 \) is one of intuitive evidences for the existence of the quark phase before the hadronization. The radial and elliptic flow of heavy quarks would also favour the strong interacting plasma phase. The modification of the near- and away-side jet shape and its relation to the elliptic anisotropy could prove the property of the matter in the phase. Experimental measurements especially on the collective motion of the high density and temperature matter created in high-energy heavy-ion collisions will be presented and discussed.

12:30PM 16HE.00005 LUNCH BREAK

2:00PM 16HE.00006 Probing the QCD Plasma with High Energy Jets
PETER JACOBS, Lawrence Berkeley National Laboratory — QCD jets - the collimated spray of hadronic fragments from hard-scattered quarks and gluons - are a ubiquitous feature of high energy collisions. Heavy ion experiments at colliders put jets to a new use, utilizing partonic energy loss and the resulting modification of jet fragmentation as a sensitive, penetrating probe of the QCD plasma. The initial RHIC discovery of jet quenching, via the suppression of high pT hadron yields and di-hadron correlations, has been followed by more detailed observations of its flavor dependence and the response of the medium to partonic energy loss. I will review recent experimental progress in this area, and the quantitative understanding of the QCD plasma that is emerging. I will also discuss new opportunities for such measurements at the LHC and upgraded RHIC.

2:25PM 16HE.00007 Modeling strongly coupled quark gluon plasmas: hydro vs transport vs general relativity
MIKLOS GYULASSY, Columbia University — The discovery of near perfect fluid flow and very high jet opacity in nuclear collisions at 200 GeV at RHIC/BNL has challenged traditional weak coupling perturbative QCD modeling of quark gluon plasmas. A critical assessment of current theoretical uncertainties facing competing approaches based on relativistic hydrodynamics, quasi-parton transport dynamics, and novel string theory inspired general relativity modeling will be presented. Special focus will be on identified (charm and bottom) heavy quark jets that will serve as powerful probes in upcoming RHIC and LHC experiments to better constrain the initial conditions as well as energy loss mechanisms leading to rapid equilibration in ultra-relativistic nuclear collisions.
Gstudies now provide a basis for extracting precision information on these strange quark contributions. In this talk, I will briefly review the experimental technique, via parity-violating (PV) elastic electron scattering. In the past 10 years, a series of definitive PV electron scattering experiments along with several theoretical

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nature. In particular, the three light neutral pseudoscalar mesons

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two-photon decays of these mesons. Since

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amplitude of the

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effects among these mesons. Theoretical activities in this field over the past several years have resulted in high precision (1% level) predictions for the decay

accurate and is exact in the limit of massless quarks. In the real world, the SU(3) and isospin breaking by the light quark masses lead to important mixing

G

p) reactions, it is shown that proton long-range correlations increase with neutron richness. Additional data is needed to determine the dependence for neutrons. The dispersive optical model is shown to allow for data-driven extrapolations to the drip-lines, but more data is presently needed to make useful predictions.

Recycler Ring and the Main Injector accelerator. The linac would utilize cryomodules, radio-frequency distribution, cryogenics, and instrumentation that are the

same as or similar to those used in the ILC, at a scale of about one percent of the full ILC linac. Building the ILC-like linac of Project X would offer substantial support for ILC development by accelerating industrialization of ILC components in the U.S. and offering an early application of ILC superconducting technology. The intense proton beam of Project X would be used to create a number of high-intensity particle beams (neutrinos, muons, charged and neutral kaons, and anti-protons) that would enable a variety of precision experiments having unprecedented sensitivity to physics beyond the standard model. Project X would also provide a foundation at Fermilab for possible future accelerator facilities such as a neutrino factory or a muon collider. This presentation will preview both the concept for the Project X accelerator facility and the physics program that it would enable.

2:42PM X2.00003 Neutrino Factories and Muon Colliders1. SEVE GEER, FNAL — The status of R&D on Neutrino Factories and Muon Colliders will be summarized together with plans and prospects for the future.

1This work was supported at Fermi National Accelerator Laboratory, which is operate by the Fermi Research Association, under contract DOE DE-AC02-76CH03000 with the U.S. Department of Energy

Tuesday, April 15, 2008 1:30PM - 3:18PM –

Session X3 DNP: Topics In Nuclear Physics Hyatt Regency St. Louis Riverfront (formerly Adam039;ski Mark Hotel), St. Louis E

2:06PM X3.00002 The strange electromagnetic form factors of the nucleon at low $Q^2$. JIANGLAI LIU, California Institute of Technology — The strange electric and magnetic form factors of the nucleon, $G_E^S$ and $G_M^S$, give the contributions of strange quarks to the charge and magnetization distributions of the nucleon, which solely arise from the sea of $s$-quarks. $G_E^s$ and $G_M^s$ can be determined by combining the well-known electromagnetic form factors of the proton and the neutron, $G_E^p$ and $G_E^n, G_M^p$ and $G_M^n$, with the neutral weak form factors of the proton, $G_Z^p$ and $G_Z^n$, which can be measured via parity-violating (PV) elastic electron scattering. In the past 10 years, a series of definitive PV electron scattering experiments along with several theoretical studies now provide a basis for extracting precision information on these strange quark contributions. In this talk, I will briefly review the experimental technique, and give a summary of the PV elastic electron scattering measurements (at low momentum transfer in particular). A global analysis to extract $G_E^S$ and $G_M^S$ from the data and the physics implications to the “strange sea” will then be presented.

2:42PM X3.00003 Test QCD symmetries via precision measurement of the neutral pion lifetime1, LIPING GAN2, University of North Carolina Wilmington — Symmetries and their dynamical breaking effects play fundamental roles in the nature. In particular, the three light neutral pseudoscalar mesons $\pi^0$, $\eta$ and $\eta'$ contain fundamental information about QCD symmetries. While $\pi^0$ and $\eta$ are Goldstone bosons due to spontaneous chiral symmetry breaking, the $\eta'$ is not due to the U(1)$_A$ anomaly. There is a second type of anomaly driving the two-photon decays of these mesons. Since $\pi^0$ is the lightest meson in the hadron spectrum, the chiral anomaly prediction for the $\pi^0 \rightarrow \gamma \gamma$ decay width is more accurate and is exact in the limit of massless quarks. In the real world, the SU(3) and isospin breaking by the light quark masses lead to important mixing effects among these mesons. Theoretical activities in this field over the past several years have resulted in high precision (1% level) predictions for the decay amplitude of the $\pi^0$ into two photons. As a result, the experimental measurement on this quantity with a comparable precision will provide an important test on the fundamental QCD predictions. The present experimental uncertainty of the $\pi^0$ decay amplitude, according to the PDG average, is an order of magnitude greater than the theoretical uncertainties. The PrimEx collaboration at Jefferson Lab has recently developed and performed a new experiment to measure the neutral pion life time with high precision using the small angle coherent photoproduction of $\pi^0$s in the Coulomb field of nucleus, i.e., the Primakoff effect. A new level of experimental precision (∼2.9% total error) has been achieved by implementing the new high intensity and high resolution photon tagging facility in Hall B at Jefferson Lab and by developing a novel high resolution electromagnetic hybrid calorimeter (HYCAL). The final result of this experiment will be presented. The advent of a 12 GeV electron beam at Jlab will make it possible to extend the program to $\eta$ and $\eta'$. A plan for future $\eta$ and $\eta'$ program will be discussed.

1This project is supported by the U.S. National Science Foundation

2For the PrimEx collaboration
**Tuesday, April 15, 2008 1:30PM - 3:18PM — Session X4 FEd FGSA: Programs to Prepare Teaching Assistants to Teach**

**1:30PM X4.00001 Preparing Undergrads to Teach (Well): The Colorado Learning Assistant Model**¹, STEVEN POLLOCK, University of Colorado, Boulder — We report here on efforts at the University of Colorado, Boulder, to implement and investigate a model program with undergraduate Learning Assistants [1], a program designed to facilitate educational reforms while also recruiting and supporting future K-12 teachers. We use the LA program to support the implementation of innovations developed by the Physics Education Research community [2,3], and we document sustained learning gains from multiple instructors that exceed twice the national average for traditional courses, as well as the promotion of expert-like beliefs about the nature of physics and learning physics[4]. A central theme of our studies is to measure and understand the impact of these reforms on three populations - faculty, students in the class, and of course the Learning Assistants themselves.


¹Research supported by the NSF and PhysTEC.

**2:06PM X4.00002 Professional development of graduate TAs: The role of physics education research**¹, MACKENZIE STETZER, University of Washington — For approximately 15 years, the Physics Education Group at the University of Washington has been offering an academic-year teaching seminar that is required for all new graduate TAs in physics. The seminar, conducted in the context of *Tutorials in Introductory Physics*², is designed to help prepare graduate students and junior faculty to teach introductory physics more effectively. In the seminar, TAs have an opportunity to learn (or relearn) basic concepts that they have likely not studied for many years, to reflect on student understanding of these concepts, and to gain experience with instructional strategies that have proved effective in helping students learn. The seminar represents an important step in developing a comprehensive, research-based TA preparation program that deepens content understanding and fosters effective instructional practices. Examples from ongoing investigations will be used to illustrate the role of physics education research in informing the design and implementation of professional development programs for future faculty.

¹This work has been supported in part by the National Science Foundation.

**2:42PM X4.00003 Preparing and Sustaining Teaching Assistants** , KENNETH HELLER, University of Minnesota — For the past 15 years, we have developed and implemented a systemic approach to using the approximately 80 teaching assistants employed by the physics department. The goal of this program is to make the experience valuable for the teaching assistants, the undergraduate students they serve, the professors, the department, and the university. This operation puts teaching assistants into teaching situations in which they can be successful and then gives them the minimal support they need to be successful. The teaching situation emphasizes their role as coaches for their students. The minimal support includes five full days of orientation to get them ready for teaching, a weekly seminar program to address components of their teaching as they arise, mentor TAs to give personal feedback, and planned meetings with the course professor to make sure that their actions are integrated into a course. This talk will describe the features of this program. Some of the materials used can be found at [http://groups.physics.umn.edu/physed/](http://groups.physics.umn.edu/physed/)

**Tuesday, April 15, 2008 1:30PM - 3:18PM — Session X5 DAP: Short Gamma-Ray Bursts**

**1:30PM X5.00001 Observations of Short Gamma-Ray Bursts** , DEREK FOX, Pennsylvania State University — No abstract available.

**2:06PM X5.00002 Triggering Short Gamma-Ray Bursts** , ENRICO RAMIREZ-RUIZ, University of California at Santa Cruz — Although they were discovered more than 30 years ago, short gamma-ray bursts are still a mystery. All that we can be confident about is that they involve compact objects and relativistic plasma. Current ideas and prospects are briefly reviewed. There are, fortunately, several new observations that could help clarify some of the issues.

**2:42PM X5.00003 Expected High Energy Prompt Emissions from Short GRBs** , SOEB RAZZAQUE, NASA/Goddard Space Flight Center —

**Tuesday, April 15, 2008 1:30PM - 3:18PM — Session X6 FPS: Space Debris**

**1:30PM X6.00001 Observations of Short Gamma-Ray Bursts** , DEREK FOX, Pennsylvania State University — No abstract available.

**2:06PM X6.00002 Triggering Short Gamma-Ray Bursts** , ENRICO RAMIREZ-RUIZ, University of California at Santa Cruz — Although they were discovered more than 30 years ago, short gamma-ray bursts are still a mystery. All that we can be confident about is that they involve compact objects and relativistic plasma. Current ideas and prospects are briefly reviewed. There are, fortunately, several new observations that could help clarify some of the issues.

**2:42PM X6.00003 Expected High Energy Prompt Emissions from Short GRBs** , SOEB RAZZAQUE, NASA/Goddard Space Flight Center —
1:30PM X6.00001 An Introduction to Space Debris, DAVID WRIGHT, Union of Concerned Scientists — Space debris is any human-made object in orbit that no longer serves a useful purpose, including defunct satellites, discarded equipment and rocket stages, and fragments from the breakup of satellites and rocket stages. It is a concern because due to its very high speed in orbit—often relatively small pieces can damage or destroy satellites in a collision. Since debris at high altitudes can stay in orbit for decades or longer, it accumulates as more is produced and the risk of collisions with satellites grows. Since there is currently no effective way to remove large amounts of debris from orbit, controlling the production of debris is essential for preserving the long-term use of space. Today, there are 90,000 satellites in orbit, spanning a wide range of civil and military uses. The 50 years of space activity since the launch of Sputnik I has also resulted in well over half a million pieces of orbiting debris larger than 1 cm in size. There are two main sources of space debris: (1) routine space activity and the accidental breakup of satellites and stages placed in orbit by such activity, and (2) the testing or use of destructive anti-satellite (ASAT) weapons that physically collide with satellites at high speed. The international community is attempting to reduce the first category by developing strict guidelines to limit the debris created as a result of routine space activities. However, the destruction of a single large spy satellite by an ASAT weapon could double the total amount of large debris in low earth orbit, and there are currently no international restrictions on these systems. This talk will give an introduction to what’s in space, the origins of space debris, efforts to stem its growth, the threat it poses to satellites in orbit, and the long-term evolution of the debris population.

2:06PM X6.00002 Considering the Consequences of Space Warfare in the Geosynchronous Region, CAROLINE REILLY, RAND Corporation — Today in the United States there is a rejuvenated push for space weapons and the restraint that was exercised regarding the military use of space during the Cold War is notably absent. This talk aims to demonstrate that space is an unacceptable arena for warfare based on the notion that fragment-generating attacks in space could cause irreparable damage to the hundreds of satellites orbiting the Earth, particularly in the invaluable geosynchronous region. In an effort to highlight the drawbacks of space weapons, a simulation entitled GeoPell modelled the consequences of a kinetic energy ‘pellet cluster’ attack initiated at the geostationary altitude. The worst-case estimate predicted by GeoPell indicated that within two years of placing the cluster of one million pellets into a retrograde geostationary orbit and subsequently dispersing the pellets with a bursting charge, almost every geosynchronous satellite would be destroyed. Thus, the technical consequences of this hypothetical space attack suggest space weapons and warfare should be avoided due to the detrimental effects such weapons would have on the orbital environment. Cooperative restraint-based measures, possibly in the form of a ban on space weapons testing and deployment, are necessary to salvage the final frontier.

2:42PM X6.00003 China’s ASAT Weapon: Capabilities and the Potential Threat, GEOFFREY FORDEN, MIT — Much has been said about China’s 11 January 2007 test of an anti-satellite (ASAT) weapon but few analysts have based their comments on a scientific determination of the weapon’s capabilities. This talk reviews in detail the publicly available evidence of the Chinese test and finds that it is less agreement. We show that the differences could be interpreted as representing small residual eccentricity in the initial orbits.
1:30PM X8.00001 Observation of the high-frequency peaked BL Lac object 1ES 1218+304 with VERITAS, RRESHMI MUKHERJEE1, Barnard College, Columbia University — We report on observations of the high-frequency-peaked BL Lac object 1ES 1218+304 with the VERITAS array of several several imaging Cherenkov telescopes located at the Fred Lawrence Whipple Observatory in Southern Arizona. A gamma-ray signal was detected with high significance for the observations taken during several months in the 2006-2007 observing season. Here we present results on the time variability and spectral properties of 1ES 1218+304, and discuss implications of the data.

1Reshmi Mukherjee for the VERITAS Collaboration

1:42PM X8.00002 Observation of very high-energy gamma-ray emission from Cassiopeia A with VERITAS, ALEXANDER KONOPELKO, Purdue University, VERITAS COLLABORATION — We report on observations of the supernova remnant Cassiopeia A carried out with the VERITAS array of four imaging atmospheric Cherenkov telescope for about 20 hrs between September and November 2007. The standard sterile analysis developed by the VERITAS collaboration reveals the excess in the direction of Cassiopeia A at the significance level of 8σ. The estimated integral flux is about 3% of the Crab-Nebula flux above 1 TeV. The data are consistent with a point-like source. These observations enable measurement of a high quality spectrum of very high-energy gamma rays. The analysis results and theoretical implications will be presented at the symposium.

1:54PM X8.00003 Observation of very high-energy gamma-ray emission from IC443 with VERITAS, VIATCHESEV BUGAEEV, Washington University, St Louis, VERITAS COLLABORATION — In 2007 the Very Energetic Radiation Imaging Telescope Array System (VERITAS) gamma-ray telescopes have been used to observe IC443, a shell-type SNR in its ISM-dominated stage of evolution that shows strong evidence of shock propagating into dense (10^5 cm^-3) OH clouds. We report on observations of IC443 carried out in spring 2007 (18 hours) and autumn 2007 (26 hours) with 3 and 4 VERITAS telescopes, correspondingly. The stereoscopic analysis developed by the VERITAS collaboration reveals the excess in the direction of IC443 at high significance level exceeding 6 sigma. These observations enable measurement of a spectrum of very high-energy gamma-rays. The analysis results and implications of the data on the origin of the high-energy emission will be presented.

2:06PM X8.00004 Multiwavelength Observations of the Blazar 1ES 2344+514, MATTHIAS BEILICKE, Washington University in St.Louis, VERITAS COLLABORATION — In 2007 and 2008, the Rossi X-ray Timing Explorer (RXTE) X-ray telescope and the Very Energetic Radiation Imaging Telescope Array System (VERITAS) gamma-ray telescope have been used to observe the blazar 1ES 2344+514. The observations captured several strong X-ray and TeV gamma-ray flares. In this contribution, we discuss the X-ray and TeV gamma-ray light curves and energy spectra. We discuss a detailed study of the correlations between the X-ray fluxes, X-ray spectral indices, TeV gamma-ray fluxes, and TeV gamma-ray spectral indices. Furthermore, we discuss implications of the data on the origin of the high-energy emission and the environment of the supermassive black hole that powers the blazar.

2:18PM X8.00005 Blazar Monitoring with the Whipple 10m Telescope, KUEN LEE, Washington University in St. Louis, VERITAS COLLABORATION — In September 2005, the observing program was redefined and the 10m was dedicated almost exclusively to AGN monitoring. Since then the five Northern Hemisphere blazars that had already been detected at Whipple, Markarian 421, H1426+428, Markarian 501, 1ES1959+650 and 1ES2344+514, have been monitored routinely each night that they are visible. Thanks to the efforts of a large number of collaborators, a significant amount of data over the entire spectrum has been gathered on these five AGN. We report here on the overview and current status of this blazars multiwavelength, monitoring campaign which is ongoing. We present lightcurves and the broadband spectral energy distributions along with an interpretation in the framework of inverse-Compton models.

2:30PM X8.00006 A Measurement of the Spatial Distribution of TeV Gamma Ray Emission from the Galactic Plane with Milagro, PETRA HUENTEMEYER, Los Alamos National Laboratory, MILAGRO COLLABORATION — Diffuse γ-ray emission produced by the interaction of cosmic ray particles with matter and radiation in the Galaxy can be used to probe the origin of cosmic rays. With its large field of view and long observation time, the Milagro Gamma Ray Observatory is an ideal instrument for surveying large regions of the Northern Hemisphere sky and for detecting diffuse γ-ray emission at high energies. The Milagro experiment has previously observed eight sources or source candidates in a Galactic plane survey. We determine the spatial distribution of the 15 TeV diffuse gamma ray emission by subtracting the flux contribution of these Milagro sources from the total γ-ray flux measured in the Galactic plane. The resulting fluxes and emission profiles are compared to the predictions of the GALPROP model.

2:42PM X8.00007 A Survey of EGRET Sources at Very High Energies, CHUAN CHEN, University of California, Irvine, MILAGRO COLLABORATION — The Milagro gamma-ray observatory employs a water-Cherenkov technique to continuously monitor the northern sky for TeV gamma-ray emission from astrophysical sources. Milagro has a high duty-cycle (~ 90%) and wide aperture (~ 2sr). Seven and half years of Milagro data are used to search for gamma-ray emission from 129 EGRET sources in the Milagro field of view in the northern sky. Constraints on the fluxes at 5 TeV and 20 TeV will be presented. Different background rejection variables are used for different energy ranges. We compare Milagro fluxes with the fluxes measured by EGRET and Whipple and their extrapolation to Milagro energies.

Tuesday, April 15, 2008 1:30PM - 3:06PM — Session X10 GGR: Alternative Gravity II

1:30PM X10.00001 Curvature, vacuum energy and the quantization of gravity, MAX CHAVES — On technical grounds pertaining the quantization of gravity we argue for the convenience of taking the metric and the connection to be independent. Then we point out that some important logical implications of this assumption have not previously been considered enough or at all. Among the latter is the existence of a second curvature tensor written, not in terms of the connection, but of the metric. The use of this term enables the construction of a Lagrangian that has a much a much more benign high energy limit than Einstein's theory, while at the same time is identical in the low-energy limit to that theory. In the high energy limit the Lagrangian becomes very similar to a Yang-Mills theory. Of course, the different behavior in these two widely separated limits requires the introduction of an energy scale. This very large scale is conveniently supplied by the vacuum energy of quantum fields. As a fringe benefit the vacuum energy from the quantum fields cancels out automatically no matter its value.
1:42PM X10.00002 Dark Energy and the Age of the Universe. JAMES DONOVAN, Shimer College — Most attempts to explain the nature and behavior of Dark Energy propose some scalar field to supply the energy, such as a cosmological constant, quintessence, phantom energy, tracker, and other scalar fields. The work described in this talk takes an entirely different tack, using a semi-classical approach to derive the dark energy from a previously unnoticed consequence of quantum mechanics on a cosmic scale. Because the age of the universe is finite, it follows that each quantum level in the universe is increased by a miniscule amount, $3 \times 10^{-33}$ eV. The total effect of this small increment of energy is cumulative over all the quantum numbers in the universe. An estimation of the net sum of all the universe’s quantum numbers (which overwhelmingly arise from gravity) is $4 \times 10^{12}$, and the product of these values yields the total extra energy arising from this quantum mechanical effect. The result is close to the accepted value for the universe’s Dark Energy content. With the additional assumption that time-dependent perturbative changes in the energy levels convert into matter, the value of the quantity of matter in the universe and the coincidence paradox are also resolved.

1:54PM X10.00003 Newtonian Gravitation and General Relativity as Possible Classical Corresponding Theories to Quantum Gravity. PHILMORE RUSSELL, North Carolina Central University — There are many traditional methods used by theoretical physicists to create a comprehensive theory of gravity that works on both the macroscopic and quantum scale. One common idea has been to unify the theory that works for gravity on the macroscopic scale, namely general relativity, with quantum mechanics, the theory that is used in modeling the behavior of entities on the micro scale. However, we propose the possibility that both the theory of general relativity and Newtonian Mechanics may be viewed as classical analogues to gravity’s true quantum nature. In the same manner that the harmonic quantum oscillator mirrors the classical one, the manner in which both theories treat gravity as a continuous potential that changes inversely with distance with respect to its source may indicate a similar correspondence, implying an underlying quantum characteristic of gravity. This also implies that both general relativity and Newtonian Mechanics are successful theories (on the large scale) by virtue of the fact that they were created specifically to model gravity on the macroscopic scale.

2:06PM X10.00004 Quantized Gravitation of Electromagnetic Waves as a Possible Solution to the Pioneer Anomaly. PHILMORE RUSSELL, North Carolina Central University — Analysis of radiometric data from the Pioneer 10 and 11 probes indicate that they are begin slowed by an anomalous constant acceleration with an average magnitude $a_p \sim 8 \times 10^{-8}$cm/s$^2$oriented with respect to the sun. We propose that the nature of the acceleration is due to a curvature of the space-time continuum caused by the sun’s light, which is predicted by G.R. We describe the acceleration as a quantized effect that depends on the frequency of the light and not the intensity, a kind of photo-gravity effect analogous to the photoelectric effect. The acceleration can be described by the equation:

$$a = \frac{h}{m}c$$

The constant used is equal to Planck’s constant and is placed in brackets to indicate it is dimensionless:

$$[h] = 6.626068 \times 10^{-34}$$

Although we associate the acceleration with the photons emitted by the Sun, we attribute the actual anomalous acceleration to gravitons associated with these photons. Any change in an emitted photon’s energy is accompanied by a change in the energy of its associated graviton. We attribute the observable (acceleration) to the energy of the graviton. A photon’s graviton’s energy changes independently of its own, so we treat it as a separate variable, in the same manner that charge, spin and mass may be separate characteristics of the same particle. Separating the magnitude of the acceleration from the energy of its photon effectively shows why the anomalous acceleration is not seen in the planets. The planets, through their gravity fields, attenuate the acceleration associated with the photons by changing their energy through gravitational red-shift. Photons approaching the planets experience an increase in energy, but a decrease in graviton energy, or acceleration. Subsequently, planets alter the degree of perturbation to their trajectories by the acceleration. As the mass of the planets are much larger than the mass of the probes, they are able to effectively mask the anomalous acceleration detected in the Pioneers.

2:18PM X10.00005 Coherent and conventional gravidynamic quantum 1/f noise. PETER H. HANDEL, THOMAS F. GEORGE, University of Missouri-St. Louis — Quantum 1/f noise is a fundamental fluctuation of currents, physical cross sections or process rates, caused by infrared coupling of the current carriers to very low frequency (soft) quanta, also known as infraquanta. The latter are soft gravitons in the gravidynamic case with the coupling constant $g = PM2/Nch$ considered here — soft photons in the electrodynamic case and soft transversal piezo-phonons in the lattice-dynamical case. Here $p=3.14$ and $F = psi$. Quantum 1/f noise is a new aspect of quantum mechanics expressed mainly through the coherent quantum 1/f effect 2g/pf derived here for large systems, and mainly through the conventional quantum 1/f effect for small systems or individual particles. Both effects are present in general, and their effects are superposed in a first approximation with the help of a coherence (weight) parameter $s'$ that will be derived elsewhere for the gravitational case. The spectral density of fractional fluctuations $S(j,f)$ for $j=e$ is $hf<|F|^2/2$ with $S(|F|^2)<F>|j|=S_j(|F|^2)<|F|^2=|4ps'j|/1-s'jM2/pfNch<4.4 10^6 M2/(pfNgram2). Here $s' = 2N/M/c2-N/s$, where $N$ is the number of particles of mass M per unit length of the current, $r$ is Schwarzschild radius, and $s'$ is our coherence (weight) parameter giving the ratio of coherent to conventional quantum 1/f contributions.

2:30PM X10.00006 Probabistic Aspect of Gravity. SHANTILAL GORADIA, Gravity Research Institute, Inc. — We postulate that every particle has a Planck size quantum mouth it stretches to interact with other particles, making all interactions between quantum mouths and the probability of an interaction between two particles is inversely proportional to the square of the statistical number of Planck lengths separating the particles [1], linking entropy, fine-structure constant and cosmological constant, explaining quantum tunneling, dark energy and some other issues consistent with some great minds. This was presented at the “Concepts of Entropy and Their Applications” conference in Melbourne, Australia on Dec 29, 2007. The natural logarithm connects the statistical entropy to thermodynamic and makes it consistent with the observed expansion of the universe with Hubble constant. [1] http://www.arXiv.org/physics/0210040

4:24PM X10.00007 A Quantum Theory of Gravity. FRANK KENEY, Particle Physics Research Co. — Research unexpectedly uncovered a single vector cross product potentially unifying gravity with the electromagnetic field. It has been long established the Poynting vector cross products $S = -E \times H$ is responsible for inertial mass in early eras from the high-intensity cosmic radiant density background, and photons of the EH field intensities mediate the electromagnetic force. However, pursuing further, Frank Keeney, president of Particle Physics Research Co., recalled that D and B fields were also carried by photons, being uniquely inseparably connected with E and B by proportionality coefficients $e_0$ and $\mu_0$, permittivity and permeability of space respectively, governing the speed of light equated as $c = 1/\epsilon_0$ from $1/\mu_0$. However, incorporating these factors yields a second Poynting vector cross product $S = \epsilon_0 E \times B$ producing matter in which D and B possess the electric flux density and B the magnetic flux density of the photon. Of significance, he found inspection of the cross product $DXB$ possesses units of momentum density per unit volume filling the immensity of space. Being a non-electrostatic field, embedded in all matter and filling space as a scalar boson, Keeney postulates this long-sought governing field of gravitation, in effect unifying these two force fields. Newton’s universal constant $G$ is shown to comprise the identical momentum flux density filling space. The field structure of the spin-2 graviton is unveiled, and taking advantage of an Einstein suggestion, theorizes our cosmic background to be a vector-displacement-tensor field which defines what is “curved” in relativity’s “curvature of spatial geometry” are matter displacement volumes to this specific density.
2:54PM X11.00008 Our Static Universe , DAVID PRESSLER, Primary Nuclear Research — There are two astronomical cause of redshift; motion, which leads to the Big Bang Theory, and the presence of an ubiquitous gravity field, which leads to a Static Universe Theory. Our position in the universe, which is considered to be at its center or in a null vector condition, where the net vectors of all the gravity field components equal zero, having no or undefined direction, is not related to the concept of potential energy. If there were no mass in the universe there would be no redshift. Herein lies the secret of redshift; the wavelength or frequency of light is altered by time dilation while traveling great distances from the emission source through 3-directional strained or deformed space, C-space. The gravitational field intensity inside a geometrical sphere of homogeneous matter is directly proportional to the radial distance (R) from its center and is at maximum at the outer surface. We remotely collect the light at the surface or outer shell of the sphere where the remote light source is at the center. The mass-distance ratio, with the increasing distance, to the resulting increasing mass (M), where redshift is directly proportional to M/R, is demonstrated mathematically by the gravity redshift formula: z = G M /c^2 R. I.e. z = 0.202 for Hydra with distance of 3.2 billion light year. Thus, the estimated constant density of our universe is 7.4 x 10–29gm/cu/cm. or where omega equals 1.

Tuesday, April 15, 2008 1:30PM - 3:18PM — Session X11 DPF: Top II Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis B

1:30PM X11.00001 Search for Flavor Changing Neutral Currents in Top Quark Decays at CDF , JENNIFER GIMMEL, University of Rochester, CDF COLLABORATION — In the CDF II detector at the Fermilab Tevatron, t\bar{t} pairs are produced in pp collisions at 1.96 TeV. We have performed a search for the flavor-changing neutral current (FCNC) decay of the top quark t \rightarrow Zq. This decay is extremely rare in the standard model, and any signal at the Tevatron would be an indication of new physics. For the summer 2007 conferences, using 1.12 fb–1 of data we presented the world’s best limit on the branching fraction B( t \rightarrow Zq) of 10.6% at 95% C.L. In this talk, we show the updated analysis with 1.9 fb–1 of data. We discriminate signal from background by exploring kinematic constraints present in FCNC events. We construct a mass \chi^2 variable and fit templates to the data, taking into account shape systematic uncertainties of the \chi^2 distribution. Using a Feldman-Cousins limit technique, we expect to set an improved limit on the branching fraction B( t \rightarrow Zq).

1:42PM X11.00002 An upper limit on the total width of the top quark at CDF , SATOMI SHIRAISHI, CDF COLLABORATION — We present the first direct experimental upper limit on the total decay width of the top quark using 955 pb–1 of the Tevatron’s pp collisions taken by the CDF II detector at the Fermilab Tevatron. We identify 253 top-antitop pair candidate events. The distribution of reconstructed top quark mass from the candidate events is fitted to template representing different values of the top quark width. The Feldman-Cousins prescription is used to extract an upper limit on the top quark width at 95% confidence level for an assumed top quark mass of 175 GeV/c^2.

1:54PM X11.00003 ABSTRACT WITHDRAWN —

2:06PM X11.00004 ABSTRACT WITHDRAWN

2:18PM X11.00005 Search for W’ boson resonances decaying to a top quark and a bottom quark , MONICA PANGILINAN, Brown University, D0 COLLABORATION — We search for the production of a heavy W’ gauge boson that decays to third generation quarks in 0.9 fb–1 of p\bar{p} collisions at \sqrt{s} = 1.96 TeV, collected with the D0 detector at the Fermilab Tevatron collider. We find no significant excess in the final-state invariant mass distribution and set upper limits on the production cross section times branching fraction. For a left-handed W’ boson with SM couplings, we set a lower mass limit of 731 GeV. For right-handed W’ bosons, we set lower mass limits of 739 GeV if the W’ boson decays to both leptons and quarks and 768 GeV if the W’ boson decays only to quarks. We also set limits on the coupling of the W’ boson to fermions as a function of its mass.

2:30PM X11.00006 Search for single top quark production at CDF using a matrix element method , PETER DONG, University of California, Los Angeles, CDF COLLABORATION — We present recent results from searches for single-top-quark production using 2 fb–1 of data accumulated with the CDF detector at the Fermilab Tevatron. We select events with one charged lepton, large missing transverse energy, and two jets, where one jet is identified as a b-quark jet using displaced secondary-vertex information from the CDF silicon detector. We employ a matrix-element analysis technique and a neural-network jet-flavor separator to improve separation of signal and background and greatly improve the sensitivity of our search.

2:42PM X11.00007 Search for single top quark production at CDF using neural networks at CDF , JI-EUN JUNG, KCHEP, CDF COLLABORATION — We present a search for electroweak single top quark production in proton-antiproton collisions using 2 fb–1 of data collected by the CDF II detector at the Fermilab Tevatron. Single top quarks are expected to be produced via virtual W’ boson exchange in t-channel and s-channel processes. We select events with one charged lepton, missing transverse energy, and two or three jets, at least one of which is identified as containing a B hadron. Bayesian neural networks are used to further separate the signal from the backgrounds. Results are presented for s-channel and t-channel single top quark production as well as the combined process.

2:54PM X11.00008 Search for single top quark production optimized for s-channel production at CDF , KOJI NAKAMURA, University of Tsukuba, CDF COLLABORATION — We present a search for single top quark production using 1.7 fb–1 of data accumulated with the CDF detector at the Fermilab Tevatron. We select events with one high-p_T lepton, large missing transverse energy and two jets with b tags. One jet must have a b tagging secondary-vertex information and the other jet’s b tag may use secondary-vertex or impact-parameter information. The kinematic fitting and the background-separation technique are designed to maximize the sensitivity to s-channel single top production.

3:06PM X11.00009 Optimizing the search for single top quark and WH production at CDF , BRUNO CASAL, Universidad de Cantabria, CDF COLLABORATION — We report new searches for single top quarks and WH production in a lepton+jets channel using 2 fb–1 of data accumulated with the CDF detector at the Fermilab Tevatron. We present ways to increase the acceptance of candidate events using complementary trigger paths. The sensitivity of our search is further improved by employing a boosted decision tree together with a neural-network jet flavor separator to better classify signal and background events in the analysis.

Tuesday, April 15, 2008 1:30PM - 3:18PM — Session X12 DPF: Searches III Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis C
1:30PM X12.00001 Search for Charged Massive Stable Particles Using Data from D0, YUNHE XIE, Brown University, D0 COLLABORATION — We report on a search for charged massive stable particles (CMSPs) by the D0 Experiment at Fermilab’s Tevatron. CMSPs are predicted in many theories beyond the Standard Model. Time-of-flight information was used in the search for pair-produced CMSPs, based on the signature of two particles, reconstructed as muons, with speed and invariant mass inconsistent with beam-produced muons. The analysis was done with data taken by the DO detector in Run II corresponding to an integrated luminosity of 1.1 fb$^{-1}$. Limits on the production of stable stau leptons, gaugino-like charginos, and higgsino-like charginos are presented.

1:42PM X12.00002 Identification of Heavy Stable Charged Particles at the CMS Experiment, SETH COOPER, University of Minnesota, CMS COLLABORATION — Heavy Stable Charged Particles (HSCPs) are predicted by a number of different supersymmetric models, and would be observable using the Compact Muon Solenoid (CMS) detector at the Large Hadron Collider (LHC). An HSCP produced at the LHC would have momentum on the order of several hundred GeV, but would travel slowly because of its large mass. This makes it possible to obtain the mass of an HSCP using velocity measurements from the silicon tracker, muon drift tubes, muon cathode strip chambers, and/or the electromagnetic calorimeter. Two methods of determining the velocity of an HSCP will be discussed: $dE/dx$ measurement and time-of-flight analysis.

1:54PM X12.00003 Heavy Stable Charged Particle Physics and Discovery Potential at CMS, JIE CHEN, University of Kansas, CMS COLLABORATION — Heavy Stable Charged Particles are predicted by various Super Symmetry and Extra Dimension models. Experimentally, they can be identified by exploiting their unique signature: a high momentum particle of the order of a hundred GeV with a low relativistic $\beta$ value. In this talk, we will describe four models predicting different types of Heavy Stable Charged Particles and use them as benchmarks for the search analysis strategy at CMS experiment. We will also show their potential reach at CMS with data based on 100 pb$^{-1}$ and 1 fb$^{-1}$ of integrated luminosity.

2:06PM X12.00004 ABSTRACT WITHDRAWN —

2:18PM X12.00005 Discriminating Supersymmetry and Black Holes at the Large Hadron Collider, ARUNAVA ROY, MARCO CAVAGLIA, The University of Mississippi — We assess the distinguishability between supersymmetry and black hole events at the Large Hadron Collider. Black hole events are simulated with the CATFISH black hole generator. Supersymmetry simulations use a combination of PYTHIA and ISAJET. Our study, based on event shape variables, visible and missing momenta, and analysis of dilepton events, shows that supersymmetry and black hole events at the LHC can be easily discriminated.

2:30PM X12.00006 Accelerator Mass Spectrometry Search for Strangelets in Lunar Soil, KE HAN, Yale University, ALEXEI CHIKANIAN, EVAN FINCH, RICHARD MAJKA, JACK SANDWEISS, JEFFREY ASHENFELTER, ANDREAS HEINZ, PETER PARKER, PETER FISHER, BENJAMIN MONREAL, JES MADSEN — The theoretical existence of Strange Quark Matter (SQM) with similar amounts of up, down and strange quarks in one single hadronic bag has been postulated for over two decades. A wide range of experimental searches for strangelets (small lumps of SQM with baryon number less than $10^6$) have been conducted but all failed to give a definite answer to the existence of SQM. Our experiment searches for strangelets in lunar soil. Cosmic ray flux deposits strangelets on the Moon with a predicted concentration (one strange oxygen per $10^{16}$ to $10^{17}$ normal oxygen atoms) of $10^6$ times higher than that on Earth. The lunar soil sample is analyzed using accelerator mass spectrometry through the tandem Van-de-Graaff accelerator at Yale University. The accelerator together with our own designed detection system enables us to identify strangelets at a level of less than 1 per $10^{17}$ atoms. We have covered mass range 48-55 amu, with a step size of a quarter amu each scan. In the next three months, we are planning to scan another 10 amu or so starting from 55 amu.

2:42PM X12.00007 Global Search for New Electroweak-Scale Physics at CDF, SI XIE, Massachusetts Institute of Technology, CDF COLLABORATION — A global search for new electroweak-scale physics at the Fermilab Tevatron is presented. With no particular new physics scenario being favored, we adopt a search strategy focusing on discrepancies with respect to the standard model prediction in over three hundred exclusive final states. This analysis of the CDF Run II high-$p_T$ data represents the most encompassing single search for new physics at the energy frontier.

2:54PM X12.00008 A Model Independent Search Using D0 Run II Data, JOEL PIPER, Michigan State University, D0 COLLABORATION — We present a status report on model independent searches at the D0 experiment using a subset of data from RunII of the Tevatron containing high-$p_T$ objects. The data is divided into non-overlapping final states and carefully compared to the Standard Model prediction. This approach complements model-dependent searches by scanning systematically across many final states some which would otherwise be considered only within the context of very specific models or not considered at all. Once all effects due to SM implementation, detector modeling and statistical fluctuations are taken into account, we search for deviations which could indicate the presence of physics beyond the Standard Model.

3:06PM X12.00009 Search for Technicolor Particles Produced in Association with a W Boson at CDF, YOSHIKAZU NAGAI, TATSUYA MASUBUCHI, Tsukuba, WEI-MING YAO, Lawrence Berkeley National Lab, CDF COLLABORATION — We present a search for the technicolor particles ($p_T \to \pi_T + W$) decaying to $l\bar{l}$ and in association with W boson in p$\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV. A dataset corresponding to an integrated luminosity of 1.9fb$^{-1}$ is used in this analysis. Selected events have one high-$p_T$ electron or muon, missing $E_T$ and two b-jets. In order to improve the sensitivity we make use of b-tagging techniques to identify and categorized events with one or two b-tagged jets. We set a 95% confidence level upper limit on the production cross section times branching ratio as a function of the mass of the technicolor particles involved in the interaction.

Tuesday, April 15, 2008 1:30PM - 3:06PM —

Session XI3 DNP: Electromagnetic Interactions II Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis F
1:30PM X13.00001 Proton Compton Scattering in the Wide-angle Regime. DAVID HAMILTON, University of Glasgow, RON GILMAN, Rutgers University, ALAN NATHAN, University of Illinois, BOGDAN WOJTSEK-HOWSKI, Thomas Jefferson National Accelerator Facility, THE JEFFERSON LAB HALL A COLLABORATION — Compton scattering on the proton in the wide-angle regime (WACS), in which the kinematic variables s, t, and u are large on the hadronic scale, is a powerful and, until quite recently, under-utilized probe of nucleon structure. Results from recent Jefferson Lab measurements on both the spin-averaged cross section over a broad kinematic range and polarization observables at a single kinematic point will be presented. These results confirm the powerful role of WACS in determining dominant reaction mechanisms in exclusive hard reactions in the few GeV domain. Unambiguous disagreement with predictions based on perturbative QCD approaches and agreement with predictions based on the handbag mechanism has been established. The results also provide access to non-perturbative proton structure information. The overall WACS program at Jlab will be presented, including plans to extend measurements into a higher kinematic regime following the 12 GeV upgrade.

1:42PM X13.00002 New proton form factor ratio measurements in Jefferson Lab Hall C. ANDREW PUCKETT, MIT, JEFFERSON LAB HALL C GEP-III COLLABORATION — Experiments E04-108 and E04-019 in Hall C at Jefferson Lab measure the ratio of the proton's electric ($G_E^p$) and magnetic ($G_M^p$) form factors using the recoil polarization technique. E04-108 will extend the $Q^2$ reach of this technique to approximately 8.5 GeV$^2$, while E04-019 will measure the form factor ratio with high precision at a fixed $Q^2$ of 2.5 GeV$^2$ and three different values of $\epsilon$ in the range $0.1 \leq \epsilon \leq 0.8$. Measuring the $\epsilon$ dependence of the form factor ratio from polarization transfer at fixed $Q^2$ will establish or significantly constrain the size of two-photon effects in elastic electron-proton scattering. Such effects have been proposed to explain the different values of $G_E/G_M$ obtained from polarization transfer and cross section (Rosenbluth separation) measurements at $Q^2 > 1$ GeV$^2$. E04-019 was completed in January 2008, and E04-108 will be completed in April-June of 2008. Form factor ratios extracted from a preliminary analysis of the data taken so far will be reported and discussed.

1:54PM X13.00003 Barely Off-shell Nucleon Structure. SVYATOSLAV TKACHENKO, Old Dominion University, CLAS COLLABORATION — We know much less about the neutron than the proton due to the absence of free neutron targets. Neutron information has to be extracted from data on nuclear targets like deuterium. This requires corrections for off-shell and binding effects which are not known from first principles and therefore are model-dependent. As a consequence, the same data can be interpreted in different ways, leading to different conclusions about important questions such as $d/u$ quark ratio at large momentum fraction $x$. The Barely Off-shell Nucleon Structure (BONUS) experiment at Jefferson Lab addressed this problem by tagging spectator protons in coincidence with inelastic electron scattering from deuterium. A novel compact radial time projection chamber was built to detect low-momentum, backward moving protons, ensuring that the scattering took place on a loosely bound neutron. The scattered electron was detected with Jefferson Lab's CLAS spectrometer. Data were taken at beam energies of 2, 4 and 5 GeV. We will present our experimental method and preliminary results on the extracted structure function $F_2^N$ of the neutron, both in the resonance and deep inelastic regions.

2:06PM X13.00004 The Effect of Pion Exchange in a Relativistic Quark Model of Baryons. T. GOLDMAN, R. R. SILBAR, Los Alamos National Laboratory — We examine the effect of adding pion exchange between quarks and pion self-energy corrections to the Los Alamos Relativistic Quark model with a short-distance cutoff of the Bethe form. The contributions to the nucleon and the $\Delta$-baryon are small. We conclude that the model is stable under this change in the sense that significant changes to the model parameters are not required.

2:18PM X13.00005 Measurement of the dressed spin effects of $^3$He. PINGHAN CHU, ANDREA ESLER, DOUGLAS BECK, JEN-CHIEH PENG, STEVE WILLIAMSON, JACOB YODER, University of Illinois at Urbana-Champaign — A new experiment to search for neutron electric dipole moment (EDM) using ultrarelativistic neutrons produced in superfluid helium. Polarized $^3$He will be utilized as a comagnetometer to detect the precession frequency of polarized ultrarelativistic neutron. An RF magnetic field will be applied to modify the effective magnetic moments of neutron and $^3$He. This dressed-spin technique, proposed by Golub and Lamoreaux, aims at a reduction of the systematic uncertainty of the EDM measurement. Using a polarized $^3$He cell prepared with the meta-stability exchange technique, we have studied the dressed spin effects for $^3$He for a variety of dressing field configurations. Results from this measurement will be presented and compared with theoretical calculations. Implications of this study on the neutron EDM experiment will also be discussed.

2:30PM X13.00006 ABSTRACT WITHDRAWN —

2:42PM X13.00007 Qweak Main Detector Status. DAVID MACK, TJNAF, QWEAK COLLABORATION — The Qweak experiment at Jefferson Laboratory will make the first measurement of the weak charge of the proton. Because this electroweak observable is suppressed in the Standard Model, even the modest projected 4% uncertainty will allow us to constrain new electron-quark interactions at the multi TeV-scale. The weak charge is measured through the small $<1$ ppm, parity-violating asymmetry in the elastic scattering of longitudinally polarized electrons from unpolarized protons. Scattered electrons pass through fused silica bars emit Cerenkov light which is collected and converted to current by phototubes. Most large procurements and R&D are complete. The status of the construction effort will be summarized. We remain on-track for installation in Spring 2009.

2:54PM X13.00008 A Prototype Diamond Multistrip Detector for the JLab Hall C Compton Polarimeter. ARRENDRA NARAYAN, Mississippi State University, JLAB COMPTON POLARIMETER ELECTRON DETECTOR COLLABORATION — A Compton Polarimeter is essential for any precision polarization experiment. The QWeak experiment at JLab will use parity violating electron scattering from the proton to perform a precision measurement of the weak charge of the proton ($Q^2_{\text{Weak}}$). This experiment requires the knowledge of the electron beam polarization at a level of ~1%. To achieve this, a Compton Polarimeter is under construction in JLab Hall C. The Polarimeter includes a recoil electron detector. The QWeak experiment plans to use a 180 $\mu$A polarized electron beam, in order to get the highest luminosity possible at JLab. At these luminosities, the typically used silicon detectors are rendered unsuitable due to rapid radiation damage. We have hence proposed a Chemical Vapor Deposition (CVD) diamond multi-strip detector for this Polarimeter. CVD Diamond detectors are well known for their radiation hardness. A prototype diamond multi-strip detector is being characterized at Mississippi State University. We will present preliminary spectra obtained from this detector. Based on the results of this study, a full scale diamond multi-strip detector is being constructed.

3 This work is supported by the US Department of Energy, Grant Number DE-FG02-07ER41528

2:18PM X13.00005 Measurement of the dressed spin effects of $^3$He. PINGHAN CHU, ANDREA ESLER, DOUGLAS BECK, JEN-CHIEH PENG, STEVE WILLIAMSON, JACOB YODER, University of Illinois at Urbana-Champaign — A new experiment to search for neutron electric dipole moment (EDM) using ultrarelativistic neutrons produced in superfluid helium. Polarized $^3$He will be utilized as a comagnetometer to detect the precession frequency of polarized ultrarelativistic neutron. An RF magnetic field will be applied to modify the effective magnetic moments of neutron and $^3$He. This dressed-spin technique, proposed by Golub and Lamoreaux, aims at a reduction of the systematic uncertainty of the EDM measurement. Using a polarized $^3$He cell prepared with the meta-stability exchange technique, we have studied the dressed spin effects for $^3$He for a variety of dressing field configurations. Results from this measurement will be presented and compared with theoretical calculations. Implications of this study on the neutron EDM experiment will also be discussed.

1 Supported in part by DOE, NSF

2 Work supported by the U.S. Department of Energy

3 This work is supported by the US Department of Energy, Grant Number DE-FG02-07ER41528
1:30PM X14.00001 Transition rates of high spin bands in $^{136}$Nd$^1$, S. MUKHOPADHYAY, University of Notre Dame, IN, USA; UGC-DAE CSR, Kolkata Centre, India, D. ALMEHED, U. GARG, S. FRAUENDORF, T. LI, P. V. MADHUSUDHANA RAO, X. WANG, University of Notre Dame, IN, USA, S.S. GHUGRE, UGC-DAE CSR, Kolkata Centre, India, M.P. CARPENTER, S. GROS, A. HECHT, R.V.F. JANSSENS, F.G. KONDEV, T. LAURITSEN, D. SEWERYNIAK, S. ZHU, Argonne National Laboratory, Argonne, IL, USA — Electromagnetic transition probabilities have been measured for the transitions in the two multi-quasiparticle rotational bands in the nucleus $^{136}$Nd. Lifetimes were obtained in a DSAM measurement at Gammasphere, using the $^{106}$Mo($^{40}$Ar, 4$n$)$^{136}$Nd reaction. The measurements are compared with new results of TAC and RPA calculations. The bands are identified as being built on two different quasiparticle configurations, with very different transition rates. These results contradict the speculation of a chiral-band pair $^1$ in this even-even nucleus. [1] E. Mergel et al., Eur. Phys. J. A 15, 417 (2002).

$^1$Supported in part by the U.S. National Science Foundation, the Department of Science and Technology, Government of India, and the U. S. Department of Energy, Office of Nuclear Physics.

1:42PM X14.00002 SU(3)-Basis Description of the Alhassid-Whelan Arc of Regularity$^1$, M.S. FETEA, University of Richmond, R.F. CASTEN, S. ECKEL, WNSL, Yale University, P.B. MANCHEV, University of Richmond — More than a decade ago Alhassid and Whelan identified an interior path connecting the U(5) and SU(3) vertices of the Casten symmetry triangle which unlike most of the rest of the interior does not exhibit chaos but rather preserves regularity. Recently, 12 nuclei whose parameters lie along this regularity were found. They all exhibit an almost one-to-one correspondence between the gamma band head and the $K=0^+$ band head. If wave functions of the nuclei on the arc of regularity are complicated when expressed in a U(5) basis, the basis in which most of the IBA calculations are done, they may be easier to work with in a SU(3) basis. Based on the SU(3) description of the wave functions, we found a couple of different degeneracies taking place around the Arc. Although the degeneracy condition disappears rapidly as one goes away from the Arc, the wave functions change much more slowly. The existence of these degeneracies are leading us to the conclusion that there may be some underlying quantum number(s) that may (approximately) be valid in the regular region.

$^1$This work was supported by NSF grants PHY 0555665, Jeffress Fund grant J-809, and U.S. DOE grants Nos. DE-FG02-91ER40609 and DE-FG02-88ER40417.

1:54PM X14.00003 Decay pathways and rotational properties of strongly deformed bands in $^{168}$Hf, W.C. MA, R.B. YADAV, H. AMRO, P.G. VARETTE, Y.C. ZHANG, Mississippi State Univ., G.B. HAGEMANN, B. HERSKIND, K.A. SCHMIDT, G. SLETten, NBI, M. CARPENTER, R.V.F. JANSSENS, T.L. KHO, T. LAURITSEN, C.J. LISTER, ANL, A. BRACCO, S. FRATTINI, B. MILLION, Univ. di Milano, Italy, J. DOMSCHEIT, H. HUBEL, Univ. of Bonn, Germany, D.J. HARTLEY, US Naval Academy, L.L. RIEDINGER, Univ. of Tennessee, S.W. ODEGARD, S. SIEM, Univ. of Oslo, Norway — Three strongly deformed bands were observed previously in $^{168}$Hf$^1$ and proposed as candidates of triaxial strongly deformed (TSD) bands. However, none of the bands was linked to known levels. Without the knowledge of level spins, parities, and excitation energies, it was difficult to gain a clear understanding of these bands. We have performed an extensive spectroscopic analysis for the $\gamma$-ray coincidence data obtained from a Gammasphere experiment at ANL. The decay pathways of TSD2 band to low-spin structures have been established, and the approximate spin values of levels in TSD1 band obtained. A detailed comparison of experimental properties of these bands and theoretical calculations, as well as the intrinsic configurations of the bands will be discussed. Work supported by U.S. DOE grant DE-FG02-95ER40939.


2:06PM X14.00004 Study of $^{171}$Hf at High Rotational Frequency, Y.C. ZHANG, W.C. MA, A.V. AFANASJEV, E. NGJOI-YOGO, D.G. ROUX, R.B. YADAV, Mississippi State Univ., G.B. HAGEMANN, NBI, M.P. CARPENTER, R.V.F. JANSSENS, T.L. KHO, F.G. KONDEV, T. LAURITSEN, E.F. MOORE, S. ZHU, ANL, P. CHOWDHURY, Univ. of Massachusetts. D.M. CULLEN, S.V. RIGBY, D.T. SCHOLES, Univ. of Manchester, M.K. DONGOLLOV, L.L. RIEDINGER, Univ. of Tennessee, D.J. HARTLEY, US Naval Academy, S. ODEGARD, Univ. of Oslo — High-spin properties of the nucleus $^{171}$Hf$^1$ were studied through the fusion evaporation reaction $^{48}$Ca($^{128}$Te,5n)$^{171}$Hf at a beam energy of 209 MeV at ANL. Decay gamma rays were measured with Gammasphere detector array. Previously known $^1$ rotational bands were extended to considerably higher spins. Six new bands were established. One of them was identified as a prolate band with a deformation enhanced than others, with an intrinsic configuration of $^2$($^{13/2}_h^2$). The proton alignments were observed at rotational frequency $\hbar \omega \sim 0.5$ MeV in several bands. The intrinsic configurations and band crossings for other bands will also be discussed based on comparisons of their properties with cranked shell model calculations. Work supported by U.S. DOE grant DE-FG02-95ER40939.


2:18PM X14.00005 Level and life-time studies in odd-odd $^{202,204}$Ti, N. FOTIADES, R.O. NELSON, M. DEVLIN, LANL, J.A. BECKER, LLNL — The $^{203,205}$Ti($^{205}$Ar, 2$n$) reactions were used to study excited states in odd-odd $^{202,204}$Ti isotopes. The data were taken using the GEANIE spectrometer, a Compton-suppressed array of 26 Ge detectors. The pulsed neutron source of the Los Alamos Neutron Science Center’s WNR facility provided neutrons in the energy range from 0.6 to 250 MeV. The time-of-flight technique was used to determine the incident neutron energies. Partial $\gamma$-ray cross sections were measured from the beam-on data while half-lives of isomers were determined from the beam-off data (typically, the half-lives that can be currently measured with GEANIE vary between a few $\mu$s to a few ms). The level schemes of $^{202,204}$Ti have been considerably enriched and extensive similarities observed between the two level schemes are observed. The previously reported first excited state in $^{202}$Ti has been decomposed into two close-lying states. In $^{204}$Ti, the structure above the previously known $7^+$ isomer (from the $\pi_{13/2}v_{h_9/2}$ configuration) at 1104-keV excitation energy has been established for the first time up to $E_x$ $\sim$2.3 MeV, while, at higher excitation energies, a lower limit for the excitation energy of the $\pi_{13/2}v_{h_9/2}$ configuration is proposed. The half-lives of the 7$^+$ isomers of $^{202,204}$Ti were measured with more precise results than the values adopted in the literature. This work was supported by the U.S. Department of Energy under Contracts No. DE-AC52-06NA25396 (LANL) and DE-AC52-07NA27344 (LLNL).
2:30PM X14.00006 Shears bands in $^{204}$At and $^{206}$Fr.\footnote{E.P. SEYFRIED, D.J. HARTLEY, US Naval Academy, W. REVIOL, D.G. SARANTITES, C.J. CHIARA, O.L. PECHENAYA, Washington University, K. HAUSCHILD, A. LOPEZ-MARTENS, CSNSM, Orsay, France, M.P. CARPENTER, R.V.F. JANSSENS, D. SEWERYNIK, S. ZHU, Argonne National Lab — Excited states above the $(10^-)$ isomers in the $N = 119$ isotones $^{204}$At and $^{206}$Fr have been observed for the first time. The experimental setup consisted of Gammasphere and the evaporation-residue detector Hercules. A beam-target combination of $^{30}$Si + $^{181}$Ta ($E_{lab} = 152$ MeV) was utilized for 20 hours in order to obtain these data (via the α$n$ and $5n$ channels, respectively). Both nuclides display a sequence of transitions with γ-ray energies between 130 and 300 keV. These structures are similar to the shears bands observed primarily in Pb nuclei \cite{1}; however, the dipole character of the γ-rays must be verified. Alignment plots for the band structures indicate that a crossing occurs at a relatively low frequency of $\omega \approx 0.23$ MeV. This is in contrast with the shears bands in the $N = 119$ Bi and Pb nuclei where no crossings are observed, and in $N < 119$ Pb nuclei where crossings are normally found at $\omega \approx 0.30$ MeV. Possible interpretations of the nature of this crossing will be discussed. \cite{1} R.M. Clark and A.O. Macchiavelli, Annu. Rev. Nucl. Part. Sci. 501, 1 (2001).

\textsuperscript{1}This work is supported by the NSF (USNA) and DOE (WU and ANL).}

2:42PM X14.00007 Non-yrast states in $^{221}$Th.\footnote{W. REVIOL, D.G. SARANTITES, C.J. CHIARA, O.L. PECHENAYA, J. SNYDER, Washington University, K. HAUSCHILD, A. LOPEZ-MARTENS, CSNSM Orsay, France, D.J. HARTLEY, US Naval Academy, M.P. CARPENTER, R.V.F. JANSSENS, T. LAURITSEN, D. SEWERYNIK, S. ZHU, Argonne National Lab — The nucleus $^{221}$Th has been studied, using the $^{207}$Pb($^{18}$O,4$n$) $E_{lab}$=96 MeV fusion-evaporation reaction and the Gammasphere + HERCULES detector combination. The $^{18}$O beam, provided by the ATLAS accelerator, had a 247.5-ns pulse structure. Based on evaporation-residue selected γ-ray coincidence data, the previously reported \cite{1} octupole band (yrast) has been extended to higher spin, but also the non-yrast structure of $^{221}$Th has been delineated. The latter includes another octupole-type band. A comparison with the neighboring nuclei $^{223}$Th and $^{219}$Ra will be presented. \cite{1} M. Dahlinger et al., Nucl. Phys. A 484, 337 (1988).

\textsuperscript{1}Supported by the US DOE (Grants DE-FG02-88ER-40406 and DE-AO02-06CH11357).

2:54PM X14.00008 Investigation of K-isomers in $^{255}$Lr and $^{256}$Rf.\footnote{H.B. JEPPESEN, I. DRAGOJEVIC, R.M. CLARK, K.E. GREGORICH, M.N. ALI, J.M. ALLMOND, C.W. BEAUSANG, D.L. BLEUEL, J. DVORAK, P.E. ELLISON, P. FALLON, M.A. GARCIA, J.M. GATES, J.P. GREENE, S. GROS, I.Y. LEE, A.O. MACCHIAVELLI, S.L. NELSON, H. NITSCHKE, L. STRAVSETRA, M. WIDERKING — Recently, K-isomers have been observed in very heavy nuclei around A$\approx$250 ($^{232,254}$No). The investigation of the decay of K-isomer states in the near super heavy nuclei gives very valuable information on the ordering of single particle orbitals in these nuclei. I would like to discuss our recent results on K-isomers in $^{256}$Rf and $^{255}$Lr. The experiments were performed at the Lawrence Berkeley National Laboratory’s 88-Inch Cyclotron and the decay of the isomers were studied at the focal plane of the Berkeley Gas-filled Separator (BGS). The nuclei of interest were produced via the $^{208}$Pb($^{50}$Ti, 2$n$)$^{256}$Rf and $^{209}$Bi($^{48}$Ca, 2$n$)$^{255}$Lr reactions.

\textsuperscript{1}This work was supported by the Director, Office of Science, Nuclear Physics, U.S. Department of Energy under contract number DE-AC02-05CH11231.}

3:06PM X14.00009 Search for Dipole States in $^{235,238}$U.\footnote{SAMANTHA HAMMOND, CHRIS ANGELL, HUGON J. KARROWSKI, UNC-Chapel Hill & TUNL, ELAINE KWAN, GENCHO RUSEV, ANTON TONCHEV, WERNER TORNOW, Duke University & TUNL, JOHN KELLEY, NCSU & TUNL — There is considerable interest in isotope-specific material identification. The presence of a particular isotope can be inferred by observing deexcitations of nuclear levels of γ-ray transitions characteristic for the isotope of interest using nuclear resonance fluorescence techniques. These high energy γ-transitions would penetrate protective shielding, thus acting as an identifier of hidden nuclear materials. Nearly monoenergetic, high-intensity and 100% polarized γ-ray beam from the H1:5 facility was used to search for low-spin states in $^{235,238}$U at excitation energies between 3 and 5 MeV. The resulting data on the distribution of dipole strength below particle emission threshold will be presented.

\textsuperscript{1}This work was supported in part by USDOE Grant No. DE-FG52-06NA20155.}

Tuesday, April 15, 2008 1:30PM - 3:18PM – Session X15 DNP: Nuclear Theory

Hyatt Regency St. Louis Riverfront (formerly Adam039;s Mark Hotel), St. Louis H

1:30PM X15.00001 Common signatures of Coulomb fragmentation of excited realistic nuclei and phase transitions in hypothetical confined matter.\footnote{JAN TÖKE, UDO SCHRÖDER, University of Rochester — The phenomenon of binary and multiple Coulomb fragmentation of realistic nuclei is compared to the time-asymptotic fragmentation of nuclear matter confined in a hypothetical freezeout volume. It is shown within the framework of schematic microcanonical nuclear thermodynamics that both types of processes may be described by similar mathematical equations and both may exhibit signatures of second-order phase transitions at onsets of different fragmentation channels. In the present context, phase transitions are identified as changes in the most likely fragmentation channel/state as the excitation energy of the system increases. They occur as the conditional entropy functions corresponding to different fragmentation channels/states cross at characteristic excitation energies. The critical role of the diffuse surface domain of finite nuclei is discussed, along with the importance of a proper approximation of the microcanonical ensemble involved.\cite{1} Supported by the U.S. D.O.E. Grant-No. DE-FG02-88ER40414.}

1:42PM X15.00002 Properties of Unitary Fermi Gas from the Epsilon Expansion. \footnote{ANDREI KRYJEVSKI, Washington University in St. Louis — An analytical technique similar to the Epsilon expansion in the theory of critical phenomena has been recently proposed for dilute Fermi gas with two body interaction characterized by infinite scattering length and zero effective range called Unitary Fermi Gas (Nishida and Son, Phys.Rev.Lett.97:050403, 2006). I will describe some recent results: 1. effective Lagrangian (Landau-Ginzburg-like functional) for Unitary Fermi Gas and its applications (superfluid vortex structure, surface tension of the normal/superfluid phase interface in the polarized (imbalanced) gas); 2. low energy density-density correlation function and the dynamic structure factor.}

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\textsuperscript{1}This work is supported by the NSF (USNA) and DOE (WU and ANL).
1:54PM X15.00003 Quasiparticle Density Functional Theory with Dispersive Optical Model Self Energies, MARK BURNETT, WILLEM DICKHOFF, Department of Physics, Washington University, St. Louis, Missouri 63130, USA — The quasiparticle extension of Kohn-Sham Density Functional Theory proposed by Van Neck et al. and further applied to atomic nuclei is promising for nuclear calculations, because overlap functions and spectroscopic factors are in principle calculable. Starting with spherical Skyrme-Hartree-Fock-Bogolyubov calculations and self energies provided by Dispersive Optical Model calculations, new quasiparticle functionals are explored for nuclei using this method.


2:06PM X15.00004 Generalized Auxiliary Field Monte Carlo method: a new efficient variational method for CBF theory, MOHAMMED BOUADANI, Arizona State University — A principle goal in nuclear theory is the development of computational methods to calculate hadronic systems properties. Correlated basis function theory, CBF, is believed to offer an accurate wave-function. Two approaches that have made important contributions are the diagrammatic viewpoint that try to compute in a self consistent way to all orders the dominant leading order diagrams such as the Fermi hypernetted Chain/ Single Operator Chain and Coupled Cluster theory, and, on the other hand, there are methods like Green function Monte Carlo, that aim to compute expectations of observables by stochastically evaluating the integrals via Monte Carlo method. Each of these approaches suffer important limitations that make further advances very difficult. To circumvent the principle obstacle, being that these correlations are state dependent and thus making any evaluation of such complex wave-function impractical for large systems, a new method designated as the Generalized Auxiliary Fields Variational Monte Carlo, GAFVMC method has been successfully implemented for the stochastic sampling of the CBF-type wave-functions with \( \nu \) type operators. Some encouraging results will be given.

1Supported by NSF grant PHY-0456609

2:18PM X15.00005 Odd-even Mass Nuclei in Nuclear Energy Density Functional Theory, NICOLAS SCHUNCK, Univ. of Tennessee, JACEK DOBACZEWSKI, University of Warsaw, Poland, MARIO STOITSOV, WITOLD NAZAREWICZ, Univ. of Tennessee — Energy Density Functional (EDF) theory provides a global and consistent framework to describe nuclear structure. Almost all of the current parametrizations of the EDF were obtained by starting from an effective two-body interaction, e.g. of the Skryme type, and only experimental observables relative to even nuclei were taken into account in the fit of the parameters of the interaction. This implies that, although the EDF is constructed out of both time-even and time-odd fields, the latter have not been really probed during the fitting procedure. A consequence of this bias is that spectroscopic properties of atomic nuclei are rather poorly described in self-consistent EDF approaches. Efficient EDF solvers together with super-computing facilities allow us to change this strategy and probe the time-odd fields in a more systematic way. The talk will briefly review the formalism of the energy density functional theory and present the first results of systematic self-consistent HFB blocking calculations in the rare-earth region. Effects coming from the interaction, from the presence of tensor terms and of time-odd fields will be presented and the consequence on the fit of new generations of functionals discussed.

2:30PM X15.00006 Meson Spectroscopy in Light-Front Quark Model, MARTIN DEWITT, CHUENG JI, North Carolina State University — Although a theory of the strong force, Quantum Chromodynamics (QCD), has existed for many years, it has not been possible to solve it exactly. As such, models based on the essential characteristics of the strong force, which have been gleaned from approximate solutions of QCD, have been very useful in understanding the properties of bound states of quarks. The light-front quark model (LFQM) has generally been successful in predicting the properties of two-body (quark-antiquark) bound states called mesons. While experimental data on mesons with certain quantum numbers have matched well with the model predictions, the \( 1^P_1 \) (scalar) mesons have not. In fact, more scalar states have been observed experimentally than should exist if they were all two-body bound states. It is suspected that other “exotic” forms of matter, which have been predicted by QCD but have never been directly confirmed in experiments, are complicating the scalar meson spectrum. These exotic states have the same quantum numbers as the scalar mesons, and are thus allowed to mix with them. The result is that the states observed experimentally are actually quantum-mechanical superpositions of the scalar mesons and these other exotic forms of matter, thus making them difficult to clearly identify. We will discuss how the LFQM is used to predict the properties of mesons in general, as well as how it can be used to shed light on the more complicated structure of the scalar states.

1DE-FG02-03ER41260

2:42PM X15.00007 A study of No-pair two-body equation with non-central potentials, CHARLES WERNETH, MILLIKA DHAR, LAWRENCE MEAD, KHIN MAUNG, The University of Southern Mississippi, USM COLLABORATION — The No-pair two-body equation was proposed by Sucher 

1some time ago but calculations have been done for central potentials only. We study the no-pair two-body equation with both central and tensor interactions and preliminary numerical results will be presented. (1) G. Hardekopf and J. Sucher, Phys. Rev. A. 30, (1984) 703

2:54PM X15.00008 Hadron Confinement Theory, CARL CASE, Case Consulting — A theory is presented based on QCD and Dirac equation solutions with well-defined energy, momentum, and angular momentum for quarks and gluons. Dynamic chiral symmetry breaking occurs when massless quarks and gluons have identical velocities resulting in color electric fields being cancelled by countervailing color magnetic fields. Massless quarks are entrapped in magnetic containment bottles, while massless gluons are entrapped in quantized bundles of color magnetic flux. Each entwined massless quark-gluon combination behaves as a composite particle that acquires mass as inertial magnetic forces reduce its velocity below the speed of light. The quark-gluon composite particles are identified with the point-like quarks observed in collider experiments. Each quark flavor is associated with one of the degenerate ground states associated with the quantized color magnetic flux bundles and their associated winding numbers. The up, charm and top quark masses obey a specific scaling law as do the down, strange and bottom quarks. The six quark flavors obey a single scaling law for the speed of each flavor relative to speed of light. Calculations of the hadron mass spectra are presented. The theory provides an explanation for the proton spin crisis.

3:06PM X15.00009 Octet Baryon Magnetic Moments from QCD Sum Rules, LAI WANG, FRANK LEE, George Washington University — We report results on the magnetic moments of octet baryons using the method of QCD sum rules. Three sum rules from three independent tensor structures are derived for each member in the octet \( (p, n, \Lambda, \Sigma^0, \Sigma^+, \Sigma^-, \Xi^0, \Xi^-) \) using generalized interpolating fields. They are analyzed in conjunction with the corresponding sum rules. The convergence of each sum rule is studied, taking into account transitions in the intermediate states. Individual \( u, d \) and \( s \) quark contributions to the magnetic moment are also isolated. The results are compared to previous calculations and experiment.

1supported in part by DOE
2:50PM 17HE.00001 Gamma-Ray Bursts from Massive Stars, ANDREW MACFADYEN, New York University — I will discuss the collapsar model for the production of cosmological gamma-ray bursts from the collapse and explosion of massive rotating stars. I will present numerical simulations of relativistic gas dynamics relevant for the propagation of hot plasma through the envelopes of stars and beyond.

3:15PM 17HE.00002 Particle Acceleration at astrophysical shocks, JOHN KIRK, Max-Planck-Institut fuer Kernphysik — I will review the status of particle acceleration theory, concentrating on the connection between acceleration and magnetic field amplification in both non-relativistic and highly relativistic shocks.

3:40PM 17HE.00003 BREAK —

4:00PM 17HE.00004 Short Gamma-Ray Burst Models and Simulations, HANS-THOMAS JANKA, Max Planck Institute for Astrophysics — While the sources of long-duration gamma-ray bursts (GRBs), at least in a number of cases, have been unambiguously identified as exploding massive stars, the origin of short GRBs is still much less certain, although a connection to compact object mergers, in particular neutron star and neutron star black hole binaries, seems very likely. What is the difference between short and long bursts? What are the possibilities to pin down the astrophysical objects that produce the short bursts? What is the status of numerical simulations, what can they tell us, and what are their limitations? The talk will address these and other questions and will show where contributions from other fields are needed for making progress. Hydrodynamic simulations of the final plunge that terminates the orbital evolution of compact binaries have made significant progress and now have begun to take into account general relativity, magnetic fields, and microphysical descriptions of dense neutron star matter. In particular the gravitational wave signal emitted from this phase and the subsequent ringdown contains very valuable information. In contrast, the following evolution of the merger remnant still poses major challenges for the modeling because of the long secular timescales, the potential relevance of different kinds of instabilities, the complexities of the neutrino transport, and the simultaneous presence and interaction of accretion and outflows on vastly varying scales. Modeling efforts were able to bring insight into selected aspects, but a consistent picture of the source that produces the ultrarelativistic GRB outflow has not been developed yet.

4:25PM 17HE.00005 Production of electron-positron pairs using ultra-intense lasers and potential applications, EDISON LIANG, Rice University — When ultra-intense lasers interact with an over-dense plasma they convert a significant fraction of their energy into relativistic superthermal electrons. When such electrons interact with the nuclei of a high-Z target, electron-positron pairs can be copiously produced via the Trident and Bethe-Heitler processes. Numerical simulations have been performed by many groups, and a number of experiments have been attempted, to study the feasibility of these concepts. This talk will review the current status of laser pair production, plans for future experiments and explore the potential applications of such high-density positron sources, from laboratory astrophysics to exciting new technologies.

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