Inaugural Fall 2009 Meeting of the Prairie Section of the APS
Iowa City, Iowa
http://www.aps.org/meetings/meeting.cfm?name=PSAPS09
At higher \( x \) in the past. At lower \( x \) modification factors in heavy ion collisions offer an opportunity to gauge cold nuclear matter properties such as parton distribution modifications and \( Q \) narrow single spin asymmetries of non-identified charged hadrons measured in the muon spectrometers (\( 1.2 \) asymmetries provides an opportunity to probe the parton structure of transversely polarized nucleons. We present PHENIX preliminary results of transverse Charged Hadrons in the PHENIX experiment at RHIC, FENG WEI — The measurement of transverse single spin asymmetry of forward charged hadrons in the PHENIX experiment at RHIC, FENG WEI — The measurement of transverse single spin asymmetry of forward charged hadrons in the PHENIX experiment at RHIC, FENG WEI — The measurement of transverse single spin asymmetry of forward charged hadrons in the PHENIX experiment at RHIC, FENG WEI — The measurement of transverse single spin asymmetry of forward charged hadrons in the PHENIX experiment at RHIC, FENG WEI — The measurement of transverse single spin asymmetry of forward charged hadrons in the PHENIX experiment at RHIC, KARSTEN M. HEEGER, University of Wisconsin — Neutrino mass and mixing are amongst the major discoveries of recent years and demand that we make the first significant revision of the Standard Model in decades. Many important questions remain: Are neutrinos their own antiparticles? What is their mass scale? Can neutrinos explain the observed baryon asymmetry in the Universe? I will review the discoveries of recent non-accelerator experiments and discuss the prospects for understanding the nature of neutrino mass with the bolometric CUORE experiment and the search for the last unknown neutrino mixing angle \( \theta_{13} \) with the Daya Bay reactor experiment.

9:06AM D1.00002 Upgrade of the PHENIX Forward Muon Spectrometers for Spin Physics at RHIC, JOHN HILL, Iowa State University, PHENIX COLLABORATION — An important part of the RHIC scientific program is devoted to the study of the origin of the proton spin. A part of the spin program is to determine the individual contributions to the proton spin from up and down quarks and their anti-quarks. The PHENIX experiment will study these contributions using the forward muon spectrometers to observe muons from the decay of W bosons produced in the collision of 250 GeV polarized protons. Charge of the W allows separation of the contributions of the various quark flavors and parity violation determines their helicities. The muon spectrometer triggers are being upgraded using RPC detectors to track charged particles and provide prompt trigger signals and prompt signals from the muon tracker to discriminate secondary charged pions from muons. The layout for the upgraded spectrometers will be shown with a discussion of the background rejection expected. RPC test results on timing, efficiency and spatial resolution will be shown.

1Supported by grants from USDOE and NSF.

9:18AM D1.00003 The Measurement of Transverse Single Spin Asymmetry of Forward Charged Hadrons in the PHENIX experiment at RHIC, FENG WEI — The measurement of transverse single spin asymmetries provides an opportunity to probe the parton structure of transversely polarized nucleons. We present PHENIX preliminary results of transverse single spin asymmetries of non-identified charged hadrons measured in the muon spectrometers \( (1.2 < \eta < 2.5) \) from transversely polarized p+p collisions at \( \sqrt{s} = 200 \text{ GeV} \) as a function of \( x_F \) and \( p_T \). PHENIX has lower \( x_F \) and higher \( p_T \) coverage than the Brahms experiment, which has made these measurements in the past. At lower \( x_F \) we can study the turn-on of the asymmetry as a function of \( x_F \), and the crossover region between pQCD and TMD factorization is at higher \( p_T \). Perturbative QCD predicts that the asymmetry should decrease as \( 1/p_T^2 \). For this purpose we also show the \( p_T \) dependent asymmetry in a very narrow \( x_F \) range around the turn-on region.

9:30AM D1.00004 Quarkonium production in heavy ion collisions measured by the PHENIX detector at RHIC, CESAR L. DA SILVA, Iowa State University, PHENIX COLLABORATION — Quarkonium \( (c\bar{c} \text{ and } b\bar{b}) \) production and its nuclear modification factors in heavy ion collisions offer an opportunity to gauge cold nuclear matter properties such as parton distribution modifications and \( QQ \) breakup in the hadronic matter. Furthermore, the quarkonium can be dissociated due to the color screening in quark-gluon plasma. Consequently, the observation of its suppression can be used as a phase transition thermometer. Finally, the quark charm coalescence is likely to enhance the charmonium abundance in deconfined matter. The PHENIX Experiment at RHIC collected large data sets with \( p+p, d+Au \) and heavy ion collisions that were used to measure quarkonium production at \( \sqrt{s_{NN}} = 200 \text{ GeV} \) in different rapidity ranges. This presentation will summarize the up to date quarkonium measurements in \( d+Au \) and \( Au+Au \) collisions obtained by PHENIX and their interpretation in view of the topics described above.

5:00PM A1.00001 REGISTRATION —

Thursday, November 12, 2009 6:30PM - 8:00PM — Session B1 Reception (6:30 - 8:00 PM) IMU 243 (Ballroom) -

8:00PM C1.00001 Welcoming Remarks —

Tuesday, November 12, 2009 8:00PM - 9:00PM — Session C1 Plenary Session IMU 243 (Ballroom) - Robin Santra, Argonne National Laboratory

8:00PM C1.00001 Welcoming Remarks —

8:15PM C1.00002 The Dark Side of Cosmology: Dark Matter and Dark Energy MICHAEL TURNER, University of Chicago — As successful as the current consensus cosmology is, it holds that 96% of the Universe exists in the form of unexplained dark matter (24%) and mysterious dark energy (71%). Unraveling the puzzles of dark matter and dark energy is at the top of cosmology’s “to do” list and key to a deeper understanding of our universe. A host of experiments – from the LHC to the Fermi Gamma-ray Space Telescope – are poised to shed light on the nature of the dark matter, and ongoing and upcoming observations of supernovae, galaxy clusters, weak lensing, and large-scale structure should illuminate dark energy.

Friday, November 13, 2009 8:30AM - 9:42AM — Session D1 Nuclear and Astrophysics IMU 335 (Iowa Room) - Christopher Fasano, Monmouth College

9:06AM D1.00002 Upgrade of the PHENIX Forward Muon Spectrometers for Spin Physics at RHIC, JOHN HILL, Iowa State University, PHENIX COLLABORATION — An important part of the RHIC scientific program is devoted to the study of the origin of the proton spin. A part of the spin program is to determine the individual contributions to the proton spin from up and down quarks and their anti-quarks. The PHENIX experiment will study these contributions using the forward muon spectrometers to observe muons from the decay of W bosons produced in the collision of 250 GeV polarized protons. Charge of the W allows separation of the contributions of the various quark flavors and parity violation determines their helicities. The muon spectrometer triggers are being upgraded using RPC detectors to track charged particles and provide prompt trigger signals and prompt signals from the muon tracker to discriminate secondary charged pions from muons. The layout for the upgraded spectrometers will be shown with a discussion of the background rejection expected. RPC test results on timing, efficiency and spatial resolution will be shown.

1Supported by grants from USDOE and NSF.

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9:30AM D1.00004 Quarkonium production in heavy ion collisions measured by the PHENIX detector at RHIC, CESAR L. DA SILVA, Iowa State University, PHENIX COLLABORATION — Quarkonium \( (c\bar{c} \text{ and } b\bar{b}) \) production and its nuclear modification factors in heavy ion collisions offer an opportunity to gauge cold nuclear matter properties such as parton distribution modifications and \( QQ \) breakup in the hadronic matter. Furthermore, the quarkonium can be dissociated due to the color screening in quark-gluon plasma. Consequently, the observation of its suppression can be used as a phase transition thermometer. Finally, the quark charm coalescence is likely to enhance the charmonium abundance in deconfined matter. The PHENIX Experiment at RHIC collected large data sets with \( p+p, d+Au \) and heavy ion collisions that were used to measure quarkonium production at \( \sqrt{s_{NN}} = 200 \text{ GeV} \) in different rapidity ranges. This presentation will summarize the up to date quarkonium measurements in \( d+Au \) and \( Au+Au \) collisions obtained by PHENIX and their interpretation in view of the topics described above.

Friday, November 13, 2009 8:30AM - 9:54AM — Session D2 AMO and Plasma IMU 243 (Ballroom) - Robin Santra, Argonne National Laboratory
8:30AM D2.00001 Scalable Quantum Information Processing with Ultracold Neutral Atoms. ARJUN SHARMA, KATHY-ANNE BRICKMAN SODERBERG, KARA LAMB, PETER SCHERPZEL, NATHAN GEMELKE, CHENG CHIN, The Department of Physics and The James Franck Institute, The University of Chicago — Remarkable experimental progress has been made over the last decade in realizing the necessary requirements for quantum information processing. Of all the approaches, cold atoms are at the forefront due to the precise control possible over both the external trapping potential and the atoms' internal structure. Two key issues are scaling up the number of quantum bits (qubits) and individually addressing qubits for targeted operation. We present an experiment able to overcome these difficulties. Two species of ultra cold neutral atoms confined in independent, overlapping optical lattices are the basis of our computer. One atomic species is loaded into a lattice with unit filling and act as qubits. The other species, less densely populated in a second lattice, are messenger atoms that allow for individual qubit addressing and aid in entangling operations. By translating the lattices, the messenger and qubits are brought into contact for qubit operations. This makes the scheme scalable to entangle any two distant qubits.

8:42AM D2.00002 In situ Microscopy of an Ultracold Atomic Gas near a Quantum Phase Transition. XIBO ZHANG, CHEN-LUNG HUNG, NATHAN GEMELKE, CHENG CHIN, University of Chicago — In situ observation of quantum phases in ultracold atoms realizes a key step in experimental many-body physics. By identifying coexisting local phases in an inhomogeneous system, in situ imaging holds promise for studying quantum criticality and dynamics. Here we study the bosonic superfluid (SF) to Mott insulator (MI) transition by applying high resolution imaging to a 2D sample. Space-dependent quantum critical point and excitations from a cesium 133 BEC loaded into a 2D potential, we drive the SF to MI transition by ramping up a 2D optical lattice. The surface density is measured by absorption imaging along the tightly confined direction. To identify the phases, we compute the local compressibility from the averaged density profile. As the final lattice depth is increased, the cloud center develops a flattened density plateau with almost zero compressibility, indicating a MI phase. We also observe suppressed density fluctuation in the MI domain, which is consistent with the fluctuation-dissipation theorem. Our technique can be extended to explore quantum fluctuations, correlations, thermodynamics, and dynamics in the quantum critical regime.

8:54AM D2.00003 The breakdown of one-dimensional fermionic and bosonic vacua in strong fields. M. WARE, T. CHENG, Q. SU, R. GROBE, Intense Laser Physics Theory Unit, Illinois State University — We compare the creation rates for particle-antiparticle pairs produced by a supercritical force field for fermionic and bosonic model systems. The rates obtained from the Dirac and Klein-Gordon equations can be computed directly from the quantum mechanical transmission coefficients describing the scattering of an incoming particle with the supercritical potential barrier. We provide a unified framework that shows that the bosonic rates can exceed the fermionic ones, as one could expect from the Pauli exclusion principle for the fermion system. This imbalance for small but supercritical forces is associated with the occurrence of negative bosonic transmission coefficients of arbitrary size for the Klein-Gordon system, while the Dirac coefficient is positive and bound by unity. We confirm the transmission coefficients with time-dependent scattering simulations. For large forces, however, the fermionic and bosonic pair creation rates are surprisingly close to each other. The predicted pair-creation rates also match the slopes of the time-dependent particle probabilities obtained from large-scale ab initio numerical simulations based on quantum field theory.

Supported by the NSF and Research Corporation.

9:06AM D2.00004 Computational approach to pair-creation processes. Q. SU, M. WARE, T. CHENG, R. GROBE, Intense Laser Physics Theory Unit, Illinois State University — We examine the spontaneous breakdown of the matter vacuum triggered by an external force of arbitrary strength and spatial and temporal variations. We derive a non-perturbative framework that permits for the first time the computation of the complete time evolution of various multiple electron-positron pair probabilities. These time-dependent probabilities can be computed from a generating function as well as from solutions to a set of rate-like equations with coupling constants determined by the single-particle solutions to the time-dependent Dirac equation. This approach might be of relevance to the planned experiments to observe for the first time the laser-induced breakdown process of the vacuum.

Supported by the NSF and Research Corporation.

9:18AM D2.00005 Space-time resolved quantum field theory. R. GROBE, Intense Laser Physics Theory Unit, Illinois State University — We have solved simplified model versions of the time-dependent Dirac and Yukawa equation numerically to study the time evolution of electrons, positrons and photons with full spatial resolution. The goal is to better understand how various particle creation and annihilation processes that require quantum field theory can be visualized. There are many open ended questions that we will address. Are particles and their antimatter companions created instantly, or do they require a certain minimum amount of time? Are they created at precisely the same location? What is the difference between a bare and a physical particle? Forces between particles are usually understood on a microscopic level as the result of an exchange of bosonic particles. How can the same microscopic exchange mechanism lead to a repulsion as well as an attraction? Do these force intermediating particles “know” about the charges of the two interacting particles? How can one visualize this exchange? Does it really make sense to distinguish between virtual and real particles? We also examine how a bare electron can trigger the creation of a cloud of virtual photons around it.

In collaboration with R. Wagner, Intense Laser Physics Theory Unit, Illinois State University; C. Gerry, Lehman College and ILP-ISU; T. Cheng and Q. Su, Intense Laser Physics Theory Unit, Illinois State University.

Supported by the NSF and Research Corporation.

Friday, November 13, 2009 10:30AM - 11:06AM
Session E1 Nuclear and Astrophysics II
IMU 335 (Iowa Room) - Christopher Fasano, Monmouth College

10:30AM E1.00001 Black Hole Thermodynamics From 2-Dimensional Conformal Field Theory in The Near Horizon Limit. LEO RODRIGUEZ, VINCENT RODGERS, TUNA YILDIRIM, University of Iowa, DIFFEOMORPHISMS AND GEOMETRY TEAM — Based on Robinson and Wilczek’s method for computing Hawking flux via the cancellation of the gravitational/chiral anomaly we construct a Liouville theory in the near horizon limit of a 4-dimensional black hole. We show a direct relationship between quantum fluctuations of the 4-dimensional black hole and fundamental topological quantities of the quantum Liouville theory. A centrally extended \( D_s f \) sub-algebra is computed for the effective near horizon theory and is compared to the derivation of the Bekenstein-Hawking entropy form via symmetries and the Cardy formula.

10:42AM E1.00002 Photoproduction of \( \phi \)-mesons in 200-Gev Au-Au collisions at RHIC. OLAMIDE OSINKOLU, Creighton University, STAR COLLABORATION — In ultra-peripheral collisions the heavy ions pass by each other at large impact parameters and do not interact through the strong interaction. The long-range electromagnetic interaction has a large cross section for the photoproduction of vector mesons. Relativistic ultraperipheral collisions are modeled with the Starlight Monte Carlo. Based on this Monte Carlo, I will discuss the expected signal from the \( \phi \rightarrow K^+ K^- \) and \( \phi \rightarrow K_S K_L\) decay channels in the Au-Au data obtained from the Solenoidal Tracker(S7/AR) at RHIC.A preliminary analysis of the 2007 200GeV Au-Au dataset will also be presented.
10:54AM E1.00003 Scattering With Euclidean Green's Functions. PHILIP KOPP, WAYNE POLYZOU, University of Iowa — We show that it is possible to compute differential cross sections using matrix elements of polynomials in $e^{-\beta H}$ in normalizable states. These matrix elements can be calculated by quadrature using reflection-positive Euclidean Green functions. The proposed method is based on an explicit "time-dependent" computation of the Moeller wave operators using the Kato-Birman invariance principle to replace the Hamiltonian $H$ by $e^{-\beta H}$ in the expression for the wave operators. The compact spectrum of $e^{-\beta H}$ allows uniform polynomial approximations of continuous functions of $e^{-\beta H}$. We tested the method using a solvable model with the range and strength of a typical nucleon-nucleon interaction and found convergence to the transition matrix elements for energies up to 1.5 GeV (and possibly higher).

**Friday, November 13, 2009 10:30AM - 11:30AM –**
Session E2 AMO and Plasma II IMU 243 (Ballroom) - Robin Santra, Argonne National Laboratory

10:30AM E2.00001 Photoionization of single-walled and double-walled fullerenes. MATT MCCUNE, DALE HOPPER, RUMA DE CHAKRABORTY, HIMADRI CHAKRABORTY, Northwest Missouri State University, Maryville, MO 64468, MOHAMED MADJET, Free University, D-14195 Berlin, Germany — We theoretically investigate the ionization of various spherical-type fullerenes illuminated by the synchrotron light. The molecular core, consisting of 35 and 70 carbon ions, is modeled by a classical jellium shell and the local density formalism is used to describe the ground state structure formed by the delocalized valence electrons. The ionization is then treated by a linearized time-dependent formalism [1]. At lower photon energies two plasmon resonances are obtained in the cross sections of the single-walled fullerenes. The height and the width of the giant low energy resonance show a systematic dependence on the number of the carbon atoms. But the behavior of the higher energy resonance as a function of the carbon-atom number is complicated. For the double-walled fullerenes, strong hybridization between the electrons of two carbon layers is obtained. This hybridization is found to affect the electrons collective motion, resulting in significant modifications in the plasmons.


10:42AM E2.00002 Computational studies of x-ray scattering from three-dimensionally-aligned asymmetric-top molecules. STEFAN PABST, PHAY HO, ROBIN SANTRA, Argonne National Laboratory — We theoretically and numerically analyze x-ray scattering from asymmetric-top molecules three-dimensionally aligned using elliptically polarized laser light. A rigid-rotor model is assumed. The principal axes of the polarizability tensor are assumed to coincide with the principal axes of the moment of inertia tensor. Several symmetries in the Hamiltonian are identified and employed to enhance the efficiency of solving the time-dependent Schrödinger equation for each rotational state initially populated in a thermal ensemble. Using a phase-retrieval algorithm, the feasibility of structure reconstruction from a quasi-adiabatically-aligned sample is illustrated for the organic molecule naphthalene. The spatial resolution achievable strongly depends on the laser parameters, the initial rotational temperature, and the x-ray pulse duration. We demonstrate that for a laser peak intensity of 5 TW/cm$^2$, a laser pulse duration of 100 ps, a rotational temperature of 10 mK, and an x-ray pulse duration of 1 ps, the molecular structure may be probed at a resolution of 1 Å.

1This work was founded by the Office of Basic Energy Sciences, U.S. Department of Energy under Contract No. DE-AC02-06CH11357.

10:54AM E2.00003 Design of Holographic Lightfields for Manipulation of Quantum Degenerate Gases. SAMANTHA KREPPLE, Carthage College, PETER ENGELS, CHRIS HAMNER, JIAJIA CHANG — Experiments with ultracold quantum degenerate gases are at the forefront of modern atomic physics. Since these gases require temperatures near absolute zero, they must be well isolated. Therefore, mechanical forces that laser beams exert on atoms can be exploited for trapping and manipulating these atoms. The goal of our studies was the investigation of holographic techniques to generate nearly arbitrary lightfields for the manipulation of ultracold quantum gases. The framework of this project, a variety of techniques for the creation of interesting lightfields were investigated both theoretically and experimentally. They include diffraction fields behind material masks made by holes in a metal plate, more complex patterns produced by transmission masks printed on overhead transparencies, as well as computer-generated binary holograms. The next major step for this project is testing these lightfields on Fermi degenerate gases and Bose-Einstein condensates.

1This work was funded by NSF under contract ATM-0852443 with SeaLane Research & Consulting.

11:06AM E2.00004 Detection of gyro-scale current layers using single spacecraft parameters. SHANSHAN RODRIGUEZ, JACK SCUDDER, University of Iowa — A single spacecraft technique using plasma, electric and magnetic field data, has been successfully performed on the detection of current layers throughout the magnetosphere. Ions have been demonstrated demagnetized at the bowshock and Chapman-Ferraro layers while electrons remain magnetized at these ion-gyro scale current layers. At the electron-gyro scale magnetic reconnection layer, this technique explicitly shows the demagnetization signatures of the electron diffusion regions (EDRs) by demonstrating a previously published reconnection event on 20010401, as well as providing a newly discovered event during a 3-year polar data search. These in situ observations of reconnection events also illustrate that electron agyrotropy, Mach number and anisotropy passing certain thresholds as required properties of EDR implied by the 2D PIC simulation.

11:18AM E2.00005 Theory for Plasma Rocket Propulsion. CROCKETT GRABBE, SeaLane Research & Consulting — Electrical propulsion of rockets is developing potentially into use of 3 different thrusters for future long-distance space missions that primarily involve plasma dynamics. These are the Magnetoplasmodynamic (MPD) Thruster, the Plasma Induction Thruster (PID), and the VASIMIR Thruster. The history of the development of electrical propulsion into these prospects and the current state of particularly the VASIMIR Thruster are reviewed. Theoretical questions that need to be addressed in that development are explored.

1This work was funded by NSF under contract ATM-0852443 with SeaLane Research & Consulting.

**Friday, November 13, 2009 11:30AM - 12:54PM –**
Session F1 Particle Physics I IMU 335 (Iowa Room) - Robert Zwaska, Fermi National Accelerator Laboratory

11:30AM F1.00001 Early Minimum Bias Physics at ATLAS. MAAIKE LIMPER, The University of Iowa, THE ATLAS COLLABORATION — The Large Hadron Collider is expected to deliver the first collisions at end of this year. One of the first measurements by the ATLAS Collaboration will be the properties of the inelastic collisions: the central particle density and transverse momentum distributions. This talk will describe the ATLAS minimum bias triggers, the performance of the low transverse momentum track reconstruction and the precision with which the minimum bias distributions can be measured with early data.
11:42AM F1.00002 Commissioning of the ATLAS Pixel Detector with Cosmic ray Data and readiness for collision. PRAFULLA BEHERA, The University of Iowa, THE ATLAS COLLABORATION — The 80-million channel state-of-the-art Pixel Detector is the innermost sub-detector in the ATLAS experiment at LHC within a pseudorapidity coverage of 2.5. It plays a critical role in charged particle tracking and secondary vertex reconstruction with its characteristic high precision. The calibration and commissioning of the Pixel Detector were accomplished in situ in the ATLAS pit with cooling and detector control system. We present the performance of the Pixel Detector from analysis of the cosmic ray data to demonstrate that the detector is ready for commissioning and highlight where it will be vital in combination with the rest of the sub-detectors in some of the physics processes. The talk will show all aspects of detector operation, including the monitoring and safety system, the DAQ system and calibration procedures.

11:54AM F1.00003 Quark and Lepton Mass Corrections in Neutrino-Nucleon Scattering1, YU SEON JEONG, MARY HALL RENO, Department of Physics and Astronomy, University of Iowa — We discuss the role of massive quark corrections for the neutrino-nucleon cross section at next-to-leading order in strong interaction corrections. The fixed flavor and variable flavor schemes for treating massive quark corrections are compared numerically. The charged lepton mass corrections to the cross section are also discussed.

1DE- FG02-91ER40664

12:06PM F1.00004 A Search for Charged Higgs in the decays of pair-produced top quarks at the Tevatron. DIEGO MENEZES, Northern Illinois University, SUPRYIA JAIN, University of Oklahoma, DHIMAN CHAKABORTY, Northern Illinois University, MIKHAIL AROV, Louisiana Tech University, DOOKEE CHO, Boston University, PHILLIP GUTIERREZ, University of Oklahoma, HARYO SUMOWIDADJO, University of California, Riverside, FREDERIQUE BADAUD, FLORENT LACROIX, LPC, Universite Blaise Pascal, D0 COLLABORATION — We present a search for charged Higgs bosons in the mass range 80 < m_H+ < 155 GeV, assuming the decay H+ → τ+ντ (and its charge conjugate). Using 0.9 fb−1 of lepton+jets data collected by the D0 detector, at the Fermilab Tevatron pp collider, we find no evidence for signal, and exclude branching ratios BR(H± → H±b) at 95% confidence level.

12:18PM F1.00005 High Energy Leptons from Muons in Transit, ALEXANDER BULMAHN, MARY HALL RENO, University of Iowa — We use a new formalism developed in our previous work to numerically evaluate the differential cross section for lepton pair production from muons in transit through rock or ice. This formalism gives better results than the approximate formulas in the literature for a large range of momentum transfers and lepton mass. The differential cross section is used to calculate underground lepton fluxes from an incident atmospheric muon flux, considering contributions from both conventional and prompt fluxes. Neutrino production of leptons is also considered. We provide a new analytic approximation for the charge current differential neutrino cross section. Comparisons of muon induced and neutrino induced electrons and taus are made for underground detectors.

12:30PM F1.00006 Generalized bumblebee models and Lorentz-violating electrodynamics. MICHAEL SEIFERT, Indiana University — The breaking of Lorentz symmetry via a dynamical mechanism, with a tensor field which takes on a non-zero expectation value in vacuum, has been a subject of significant research activity in recent years. In certain models of this type, the perturbations of the “Lorentz-violating field” about this background may be identified with known forces. I present the results of applying this interpretation to the “generalized bumblebee models” found in a prior work. In this model, the perturbations of a Lorentz-violating vector field can be interpreted as a photon field. However, the speed of propagation of this “bumblebee photon” is direction-dependent and differs from the limiting speed of conventional matter, leading to measurable physical effects. Bounds on the parameters of this theory can then be derived from resonator experiments, accelerator physics, and cosmic ray observations.

12:42PM F1.00007 Muon veto system and backgrounds of the DayaBay experiment, BRANDON SEILHAN, Illinois Institute of Technology, DAYABAY COLLABORATION — The DayaBay reactor neutrino experiment aims to measure the last unknown neutrino mixing angle θ13. To reach our goal sensitivity of sin2 2θ13 < 0.01 we must identify and veto cosmic ray induced backgrounds at each of our three detector sites. The DayaBay experiment combines a water Cherenkov detector with RPCs to tag muons with an overall efficiency exceeding 99.5%. This talk will provide an overview of the DayaBay muon veto system and potential cosmic ray induced backgrounds.

Friday, November 13, 2009 11:30AM - 12:54PM –
Session F2 Condensed Matter Physics I IMU 243 (Ballroom) - Giovanni Vignale, University of Missouri

11:30AM F2.00001 A Multispectroscopic Structural Study of Lead Silicate Glasses over an Extended Range of Compositions1. S. FELLER2, Coe College — A series of lead silicate glasses, spanning the broadest reported range of lead contents (up to 83 molar percent PbO), were prepared, on which the following spectroscopic observations were made: 29Si magic angle spinning NMR, MS-TOF, Raman and FTIR. For bulk, splat-quenched samples, infra-red results indicate that the lever rule (Qm → Qm−1) is approximately followed until about 60 molar percent PbO, though with considerable dissociation of the stoichiometric groups into silicate units with lesser and greater numbers of non-bridging oxygens as shown in the equilibrium relation 2Qm → Qm+1 + Qm−1. For roller-quenched samples, NMR data are consistent with a statistical distribution up to this lead concentration. Above 60 molar percent PbO, added oxygen remains associated with lead to form a separate lead oxide glass network. The evidence for this comes from each of the spectroscopic techniques employed. A quantitative distribution of PbO is given.

1The National Science Foundation is thanked for support under grants DMR 0211718 and DMR 0520518.

2G. Lodden, A. Riley, T. Edwards, J. Croskrey, A. Schue, D. Liss, D. Stentz, S. Blair, M. Kelley, G. Smith, S. Singleton, M. Affatigato, Coe College; D. Holland, M.E. Smith, University of Warwick; E.I Kamitsos, C.P.E. Varsamis, E. Ioannou, NHRF, Greece

12:06PM F2.00002 Controlling the spin-orbit amplitude in a non-flat quantum well1, OLEG CHALAEV, GIOVANNI VIGNALE, University of Missouri-Columbia — Using the inverse-scattering theory, we adjust the wave functions of a quantum well so that electrons occupying two lowest subbands conserve their spin projection, while the electrons occupying the third subband experience Rashba spin-orbit interaction. Shifting the Fermi level in the well with an external gate, one can drastically change the strength of the spin-orbit interaction felt by electrons. Such system can work as a spin-orbit trigger which has two states: (i) when the spin projection is a constant and (ii) when the spin precesses due to the spin-orbit interaction.

1Work supported by ARO Grant No. W911NF-08-1-0317.
12:18PM F2.00003 Characterization of PLZT Thin Films, HASITHA GANEGODA, CARLO SEGRE, Illinois Institute of Technology, BEIHAI MA, Energy Systems Division, Argonne National Laboratory, LIDENS CHENG, JEFF TERRY, Illinois Institute of Technology — Ferroelectric lead lanthanum zirconate titanate (Pb$_{12}$La$_{0.80}$Zr$_{0.72}$Ti$_{0.48}$) of various thickness (∼50-300nm) were fabricated by spin-coating metallo-organic solutions on Pt/TiO/SiO2/Si substrates, followed by heat treatment. The films were observed to be uniform and polycrystalline in nature. Slight modifications to the processing technique yielded either metallic or non-metallic samples. Increasing metallicity in the reaction products of the film may be one of the key factors that result in high leakage current in film-on-foil capacitors, which is detrimental to their operation as high voltage capacitors. In order to understand the mechanisms that resulted in metallic films, we utilized synchrotron radiation techniques for characterization. The samples were investigated using x-ray diffraction, photoemission, absorption spectroscopy, and resistance. Our preliminary measurements have shown interdiffusion of the metal foil into some of the thin films. Photoemission measurements show single peaks for Pb and Zr in the thinnest sample while thicker samples exhibit splitting for each of these peaks suggesting the existence of Pb and Zr in more than one chemical environment.

12:30PM F2.00004 Magnetic impurities in Graphene: Electronic structure and RKKY interaction, MOHAMMAD SHERAFATI, SASHI SATPATHY, Department of Physics and Astronomy-University of Missouri Columbia — Graphene, a recently produced allotrope of carbon, is formed in a two-dimensional honeycomb structure and is a material of considerable current interest because of the possibilities in nano-device applications. Because of its unique linearly-dispersive band structure, graphene can have properties very different from any other two-dimensional material. We will present the nature of magnetic interaction between two magnetic impurities such as Fe placed on single layer graphene sheet. Results will be presented from detailed ab-initio electronic structure calculations as well as simple models incorporating the linear dispersion and compared to the results of the standard Ruderman-Kittel-Kasuya-Yosida model. It is shown that the linearly-dispersive band structure plays a significant role in determining the magnetic interaction between iron atoms.

12:42PM F2.00005 Mechanisms of Laser Induced Modification of Lead and Barium Vanadate Glasses1, MARIO AFFATIGATO, RUHIL DONGOL, LANDON TWEETON, CORY FARIS, STEVE FELLER, Coe College — We report on our investigations on the mechanisms for structural and morphological change in lead and barium vanadate glasses modified by 785 nm laser irradiation. The fundamental process is thermal in nature, leading to phase decomposition, phase changes, and mass transport in the center of the irradiated region, as well as the formation of lead- or barium-rich debris zones. Crystalization is also a consequence of the exposure to the laser light. We further report on pre-irradiation experiments in which low-power exposure above a determined energy threshold results in structural changes that bridge the gap between the amorphous state and the ultimate crystalline arrangement. Finally, we discuss the application of the laser irradiation in the making of vanadate microspheres.

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Friday, November 13, 2009 2:00PM - 3:24PM — Session G1 Particle Physics II

2:00PM G1.00001 J/ψ Production Mechanism Measurements at PHENIX, TODD KEMPEL, Iowa State University, PHENIX COLLABORATION — Since the discovery of the J/ψ meson in 1974, several attempts have been made to model the mechanism for its production. No model has yet been able to describe all available data, but experimental progress can be made by making cross section measurements at different energies and polarization measurements for all accessible J/ψ transverse momenta. The capability of the RHIC accelerator to operate at high luminosities for center of mass energies of both 200 and 500 GeV gives an exciting opportunity for the PHENIX experiment to make a significant contribution to the search for a J/ψ production mechanism. In addition to cross section and polarization measurements, J/ψ production from transversely polarized p + p collisions also provides the potential for a new probe of the production mechanism.

2:12PM G1.00002 CMS HF PMT Abnormal Event Simulation, ANTHONY MOELLER, University of Iowa, CMS COLLABORATION — Test beam results from 2004 showed that both muons and pions could penetrate through the entire Hadronic Forward (HF) calorimeter of the Compact Muon Solenoid (CMS), striking the PMT windows directly. The particles traveling through the window create Cherenkov radiation, depositing an abnormally large amount of energy compared to the energy collected from the HF. A detector simulation of HF created with Geant4 and CMS Software (CMSSW) was used to investigate this effect. Results for the particles used in test beam (electrons, muons and pions) are included. Also included are results from simple Pythia generated jets. Rates of abnormal events, timing information, as well as results from a few simple abnormal event rejection algorithms are presented.

2:24PM G1.00003 Finite Size Scaling and Universality in SU(2) Lattice Gauge Theory at Finite Temperature, YUZHI LIU, ALAN DENBLEYKER, YANNICK MEURICE, Department of Physics and Astronomy, University of Iowa, ALEXANDER VELIYTSKY, Physics Department, Brookhaven National Laboratory — We study the 4-th Binder cumulant on $N_s \times N_t$ lattices for a pure SU(2) gauge theory. We use a finer $\beta$ resolution than previous studies in intervals shrinking with the volume in order to reduce the nonlinear effects. We compare different error analysis procedure for the Binder cumulant. We discuss the significance of the small discrepancies between our estimates of the critical exponents and the known values for the 3D Ising model.

2:36PM G1.00004 Measurement of W Boson Helicity at ATLAS, SUYOG SHRESTHA, Iowa State University — The Standard Model predicts that the top quark almost always decays via the V-A charged current interaction to a W boson and a b quark. It also predicts the fractions of W bosons produced in each polarization state. A measurement of W boson helicity fractions significantly different from the SM values would be an indication of new physics. In this talk I will present results from a Monte Carlo study with an integrated luminosity of 730 pb-1 for the measurement of W boson helicity at ATLAS.

2:48PM G1.00005 Volume Effect of Fisher zeros in the Nonlinear sigma model, HAIYUAN ZOU, YANNICK MEURICE1, University of Iowa — In lattice gauge theory, finite size scaling is an important tool to understand finite volume effects and to discriminate among different types of phase transitions. We discuss related issues for 2-dimensional O(N) sigma models in the large-N limit. These models have features similar to 4-dimensional SU(2) and SU(3) gauge theories (asymptotic freedom, mass gap, absence of phase transition at real coupling). We discuss the gap equation at finite volume for complex values of the ’t Hooft coupling. We show that the singular points of this equation correspond to the end of lines of complex zeros of the partition function. We discuss the scaling of the density of zeros with N and the volume. We briefly discuss the implications of these results for gauge theories.

1 advisor
3:00PM G1.00006 What Happened to the Spin Crisis in High Energy Physics? GORDON RAMSEY, Loyola University Chicago — Twenty years ago the European Muon Collaboration (EMC) surprised the high-energy world with data that implied the spin of the proton is mostly carried by gluons and not the valence quarks. This resulted in a spate of activity to explain the apparent disagreement of theory and experiment. This paper reviews the theoretical and experimental developments since then to shed light on the spin structure of the proton and neutron. Future plans for extending this to heavier baryons will be discussed.

3:12PM G1.00007 Study of CMS HF Candidate PMTs With Muons And Cerenkov Light in Electron Showers JAMES WETZEL, The University of Iowa, CMS COLLABORATION — The response of four different types of PMTs to muons traversing the PMT window at different orientations is measured at CERN H2 test beam. These candidate PMTs for CMS HF upgrade show significantly lower response to PMT window incident muons compared to the currently installed HFPMT due to their thinner windows. For the four anode PMT, a simple and powerful algorithm to identify such events and recover the signal using the remaining quadrants is also presented. For the measurement of PMT responses to Cerenkov light, the HF calorimeter signal was mimicked by different setups in electron beams and the candidate PMT performances were compared with each other and with HFPMT. Superior performance of particular candidate PMTs was observed against HFPMT.

Friday, November 13, 2009 2:00PM - 3:24PM – Session G2 Condensed Matter Physics II IMU 243 (Ballroom) - Giovanni Vignale, University of Missouri

2:00PM G2.00001 Role of Competing Interactions on the Nature of Carriers at a Model Polar Oxide Interface BIRABAR NANDA, SASHI SATPATHY, University of Missouri-Columbia — Transport measurements of the polar oxide interfaces like LaAlO$_3$/SrTiO$_3$ have revealed a rich variety of physical properties such as a Kondo resistance minimum, metallicity, insulation, superconductivity, and possibly also magnetism under varying experimental conditions. We present a mean-field study of a model Hamiltonian, appropriate for the polar oxide interfaces, that includes the electron hopping, Jahn-Teller coupling, and Coulomb interaction terms. Our results predict the existence of a number of interesting phases, viz., a 2D metallic or polaronic phase as well as 3D metallic or a polaronic phase depending on the relative strengths of these interactions. Under appropriate conditions, a mixed phase may also result consisting of 2D polarons and a 3D metal. In the polaronic phase, the combination of Jahn-Teller coupling and Coulomb terms could form magnetic centers. In addition, our results also reveal the possibility of a phase separation, where for some carrier concentrations, the system phase separates into a 2D like region and a 3D region. This will have important implication for the interpretation of the transport measurements. Work supported by the US Department of Energy.

2:12PM G2.00002 In Situ XAFS studies of the oxygen reduction reaction on carbon supported Pt and PtNi(1:1) catalysts QINGYING JIA, EMILY LEWIS, COREY GRICE, EUGENE SMOTKIN, CARLO SEGRE, BCPS DEPARTMENT & CSRRI, ILLINOIS INSTITUTE OF TECHNOLOGY TEAM, NORTHEASTERN UNIVERSITY CENTER FOR RENEWABLE ENERGY TECHNOLOGY (NUCRET) COLLABORATION, NUVENT SYSTEMS, INC. COLLABORATION — We have conducted Pt $L_3$ and Ni K edge in situ XAFS measurements on carbon supported Pt and PtNi(1:1) nanoparticle catalysts under a wide range of operating potentials. We observe that in PtNi alloys the Pt-Pt bond distance is shorter and the distribution of Pt and Ni is non-uniform: Pt has a tendency to be found on the surface while Ni is mostly in the interior of the catalyst nanoparticles. In addition, while a change in oxidation of the pure Pt nanoparticles is clearly observed at different potentials, the Pt in the PtNi alloy remains nearly oxygen-free at all potentials but an accompanying oxidation change of Ni has been observed instead. This phenomenon suggests that the presence of Ni inhibits the coverage of oxygen adsorbate on Pt surface, resulting in more active sites on the Pt surface.

2:24PM G2.00003 High Speed Single Dopant Spin Manipulation with a Single Electrical Gate VICTORIA POVLUS, University of Iowa Department of Physics and Astronomy — Ultra-low-power computation with spin based electronics can be achieved through coherent spin manipulation. Naturally occurring Mn ions with a bound hole in GaAs provide a uniform system with the potential for fast, all electrical spin manipulation applicable to high-density scalable spin-based electronics [1] and can be probed optically [2]. In an effort to increase device scalability by utilizing a single gate we consider a configuration in which three fields, DC magnetic, DC electric and AC electric, are parallel. With a DC magnetic field of 2.5 T and total electric field strength of 200kV/cm, we predict Rabi periods on the order of picoseconds with high visibilities. Assuming each Mn experiences a random electric field, which modifies its spin precession, we performed an ensemble calculation using this Hamiltonian to predict polarization curves from a PL measurement on low concentration Mn in GaAs. In addition we calculate how these curves are affected by a bias DC electric field.


2:36PM G2.00004 Jamming in Frictionless and Frictional Systems LEO SILBERT, Southern Illinois University, SIU TEAM — The study of jamming in static packings of frictionless spheres has revealed many interesting features that signal the approach of the jamming transition as the packing fraction is varied. This has motivated recent efforts to investigate how jamming occurs under the influence of other parameters such as shearing and thermal agitation. Using granular dynamics simulations we compare and contrast how signatures of jamming in frictionless and frictional systems depend on how the jamming transition is approached. In static systems the packing fraction is varied as previously studied in purely frictionless systems. This method provides a suitable method to identify the random loose packed state. In the other case, structural and dynamical features are studied in granular flows down an inclined plane as the inclination angle is reduced towards the angle of repose.

2:48PM G2.00005 Drude weight and optical conductivity in doped graphene: effects of electron-electron interaction SAEDI H, ABEDINPOUR, Department of Physics and Astronomy, University of Missouri, Columbia, Missouri 65211, USA, MARCO POLINI, NEST-CNR-INFM and Scuola Normale Superiore, I-56126 Pisa, Italy, ALLAN H. MACDONALD, Department of Physics, The University of Texas at Austin, Austin, Texas 78712, USA, GIOVANNI VIGNALE, Department of Physics and Astronomy, University of Missouri, Columbia, Missouri 65211, USA — The long wavelength behavior of collective modes in ordinary electron liquids with parabolic dispersion is protected from many-body renormalizations by Galilean invariance. In this talk, we will show how the absence of Galilean invariance in the massless Dirac Hamiltonian for a single layer doped graphene implies strong renormalization of Drude weight, optical conductivity and collective modes, even in the long wavelength limit. The physical origin of these renormalizations lies in the coupling between orbital and pseudospin degrees of freedom. Our predictions can be tested by using inelastic light scattering and infrared spectroscopy.

This work is supported by NSF Grant No. DMR-0705460.
The Aharonov-Bohm (A-B) effect provides direct proof that the charged fermion fields are directly coupled to the gauge 4-vector potential. In this work the A-B effect is studied by means of the relativistic time-dependent Dirac equation coupled with static, external electromagnetic potentials. The staggered leap-frog numerical method is used and proven to be stable and accurate.

As an example, an average fidelity of ninety-six percent can be obtained using an eleven-spin encoding to transmit a state over a chain containing ten-thousand spins. An analysis of the magnetic field dependence is given, and conditions for field optimization are provided.

The relativistic time-dependent Aharonov-Bohm effect in two spatial dimensions is generally incompatible to the antiferromagnetic phase, the unconventional $s^{++}$ state can coexist with magnetism depending on the Fermi surface topology. Neutron diffraction data on Ba$_2$Fe$_{1-x}$Co$_x$O$_3$ supporting these conclusions are also presented.
4:42PM H1.00007 A precision force microscope for biophysics, GAVIN KING, University of Missouri-Columbia, ALLISON CHURNESIDE, THOMAS PERKINS, JILA. NIST/CU Boulder — Single-molecule force spectroscopy studies have produced rich insights into the unfolding of individual proteins. In a typical force spectroscopy experiment, an atomic force microscope (AFM) tip is coupled to a surface-adsorbed protein and force-extension curves are generated by retracting the tip using a piezolectric (PZT) stage. Force is measured by cantilever deflection. Extension, or more precisely tip-sample separation, is deduced from the PZT stage position used to control the vertical tip position. Thus, this deduced extension is sensitive to vertical mechanical drift of the AFM assembly. We have previously developed an ultrastable AFM in which the tip and the sample positions are independently measured by, and stabilized with respect to, a pair of laser foci in three dimensions. These lasers establish a local reference frame that is insensitive to long-term mechanical drift of the AFM assembly. We have now extended the ultrastable AFM capabilities into liquid and can routinely mechanically unfold proteins at slow pulling velocities, which allows averaging to increase precision. We can also stop pulling altogether and stabilize the tip-sample separation while measuring force. Using these techniques, we are studying the unfolding and re-folding of bacteriophodopsin, a model transmembrane protein.

4:54PM H1.00008 Redefining Time to Understand Space, THOMAS SILLS, Wright College, Chicago, IL — In a new book, What Einstein Did Not See, Thomas W. Sills presents a new approach to both time and space. For the first time, readers see how Euclidean geometry can describe space with more than three dimensions. This new approach redefines time into two distinct component measurements: a vector of Timespace and a scalar of Universal Time. Three-dimensional projections from four-dimensional Euclidean space can now visually illustrate time travel. Contraction of Timespace, the fourth physical dimension, becomes equivalent to Einstein’s time dilation. General knowledge of Euclidean geometry allows the reader to understand the complex nature of higher dimensions in a new way. Readers enjoy a friendly, informative walk into four, and higher, dimensions of space. Timespace and Universal Time revolve conventional physics which defines time by what clocks measure. These new ideas transform the three-dimensional world of conventional physics.

5:06PM H1.00009 The Proof of the “Vortex Theory of Matter”, RUSSELL MOON, Dr — According to the Vortex Theory, protons and electrons are three-dimensional holes connected by fourth-dimensional vortices. It was further theorized that when photons are absorbed, then reemitted by atoms, the photon is absorbed into the proton, moves through the fourth-dimensional vortex, and reemerges back into three-dimensional space through the electron. To prove this hypothesis, an experiment was conducted using a hollow aluminum sphere containing a powerful permanent magnet suspended directly above a zinc plate. Ultraviolet light was then shined upon the zinc. The zinc emits electrons via the photoelectric effect that are attracted to the surface of the aluminum sphere. The sphere was removed from above the zinc plate and repositioned above a sensitive infrared digital camera in another room. The ball and camera were placed within a darkened box inside a Faraday cage. Light was shined upon the zinc plate and the picture taken by the camera was observed. When the light was turned on above the zinc plate in one room, the camera recorded increased light coming from the surface of the sphere within the other room; when the light was turned off, the intensity of the infrared light coming from the surface of the sphere was suddenly diminished. Five other tests were then performed to eliminate other possible explanations such as quantum-entangled electrons.

3:30PM - 3:30PM
Session H2 Poster Session (3:30 - 5:15 PM) —

H2.00001 Quantum Causality Threshold and Paradoxes, FLORENTIN SMARANDACHE, University of New Mexico, Gallup Campus — In this paper we consider two entangles particles and study all possibilities when both or some of them are immobile, or both or some of them are moving in various directions, and study the causality between them and the paradoxes generated. We define the Causality Threshold of a particle A with respect to another particle B.

H2.00002 Initial Results From Project RESUN, A Radio Search For UHE Neutrinos Using The EVLA, THEODORE JAEGGER, ROBERT MUTEL, KENNETH GAYLEY, University of Iowa — The origin, composition, and acceleration mechanism of the highest energy cosmic rays all remain mysteries in astrophysics. However, with measurements indicating an attenuation of the cosmic ray flux for energies greater than $10^{19}$ eV, Ultra High Energy (UHE, $E > 10^{18}$ eV) neutrinos may be the only observable indicators of the extreme universe. While the past 20 years have seen numerous experiments aimed at observing these cosmic messengers, no attempts have yielded a detection. In this light, we present the initial results of the Radio EVLA Search for UHE Neutrinos project. RESUN utilizes highly sensitive antennas to monitor the lunar limb for short-duration radio Cerenkov bursts associated with UHE neutrino interactions. With the first 50 hour implementation of the setup described in this paper, we have already improved the lunar-based UHE particle flux upper limit by a factor of 2 for energies greater than $10^{19}$ eV. A 200 hour observation (beginning September 2009) will achieve as much as a factor of 100 improvement over previous lunar searches, potentially making the first UHE neutrino detection and unraveling the unknown mysteries of intense astrophysical processes. Also discussed is the difference between lunar observations and ongoing Antarctic ice experiments, and how the results from lunar target experiments compare and compliment their terrestrial counterparts.

H2.00003 A Possible Explanation For NuTeV's Anomalous Dimuon Events1, THOMAS ALEXANDER, ANDREW ALTON — We consider a model where WIMPs interact with neutrinos to produce dimuon events as a possible explanation of the NuTeV anomalous dimuon events. The NuTeV events show limited sensitivity to the mass of the WIMP but they are sensitive to the mass difference between the WIMP and a more massive charged particle. While the cross section revealed by this model is unusually large the model naturally accounts for the asymmetry between the muon’s momentums as well as other features of the NuTeV events.

1 We would like to acknowledge the South Dakota Space Grant Consortium, NASA, and ARAF for funding this research.

H2.00004 A General Search for Undiscovered Particles Using the ATLAS1, ESTEBAN FULLANA TORREGROSA, JASON BOOMSMAN, SERGUEI CHEKANOV, Argonne National Laboratory, ATLAS GROUP © HEP DIVISION © ANL TEAM — We present a tool to make a comprehensive and generic search for deviations from the Standard Model in the ATLAS detector at the LHC. The search is based on the invariant mass and the sum of the Pt of the put objects. The program runs over ROOT ntuples and it is fully configurable in terms of input particles (up to six), selection cuts and output histograms. We present the results of successfully running the tool over several physics MC samples and several types of input objects including missing Et, jets, electrons, photons, muon and Z bosons.

1Supported by U.S. DOE under Contract No. DE-AC02-06CH11357.
H2.00005 Cosmic muon analysis in the ATLAS detector\(^1\)  MARI A BELEN SALVACHUA FERRANDO, NATHAN GARDNER, RIKUTARO YOSHIDA, Argonne National Laboratory, ATLAS GROUP @ HEP DIVISION @ ANL TEAM — We present a study of the muon to electron response in the Tile calorimeter of the ATLAS detector. The result is based on the analysis of 241,000 cosmic muons events in which we compare the energy response from the calorimeter with the momentum difference between the muon spectrometer and the inner detector. The ionization energy measurement as function of the momentum of the incoming muon is compared with the Bethe-Block prediction; the results show a good a correlation between the calorimeter response and the difference between the measured momentum after and before the calorimeter.

\(^1\)Supported by US DOE under Contract No. DE-AC02-06CH11357.

H2.00006 Galactic Rotation without Dark Matter: Solar System Perspective  CHUCK GALLO, JAMES FENG, Superconix Inc. — Planetary rotation around our Sun is described with Newtonian gravity/dynamics. These two-body calculations balance gravitational and centrifugal forces to yield stable orbits. The rotation of disk galaxies involves the gravitational interaction of many bodies, but this data is also described with Newtonian gravity/dynamics by balancing all the gravitational forces against the centrifugal forces at each and every point in the galactic disk to yield stable rotation. A thin disk galaxy is complex mathematical problem that does NOT have an analytical solution. Numerical (computational) techniques are required to obtain an accurate UNIQUE STABLE solution for the radial mass distribution to yield any specific measured rotation curve. Both the Solar and Galactic rotation descriptions are achieved without Mysterious Dark Matter which has never been experimentally detected. Speculations re Dark Matter are NOT required to describe the galactic rotation curves and achieve stability, only Newtonian physics with numerical solutions enabled by modern computational techniques.

References:

H2.00007 The Gravity and Extreme Magnetism Small Explorer (GEMS)  PHILIP KAARET, University of Iowa, JEAN SWANK, KEITH JAHO DA, TIM KALLMAN, NASA/GSFC, GEMS TEAM — The Gravity and Extreme Magnetism Small explorer (GEMS) was recently selected for flight in 2014 by NASA and will make the first sensitive search for X-ray polarization across a wide set of source classes including stellar black holes, Seyfert galaxies and quasars, blazars, rotation and accretion-powered pulsars, magnetars, shell supernova remnants and pulsar wind nebulae. GEMS will observe 35 targets during the 9 month prime mission. A possible science enhancement option would extend the mission with a 15 month guest observer phase. GEMS is implemented using time projection chamber (TPC) polarimeters with high efficiency in the 2-10 keV band behind thin foil mirrors. It also allows a small Bragg reflection soft X-ray experiment to be included that can extend the sensitivity to 0.5 keV. The entire spacecraft, less the solar panels, is rotated to enable measurement and correction of systematic errors. We will discuss the design of GEMS and the planned science program.

H2.00008 The Student Experiment on the GEMS Mission  RYAN ALLURED, PHILIP KAARET, ZACHARY PRIESKORN, ALICIA MAXWELL, University of Iowa, GEMS TEAM — The Gravity and Extreme Magnetism Small Explorer (GEMS) is an exciting new mission that will make X-ray polarization measurements of a large number of objects of different classes. The main instrument is sensitive in the 2-10keV band. Students at the University of Iowa are currently building a Bragg Reflection Polarimeter (BRP) that will supplement the main instrument by providing sensitivity at 500eV. The BRP consists of a multilayer crystal reflector, a proportional counter, and electronics. The multilayer crystal will be used to reflect the soft X-rays from the telescope beam to the proportional counter. In addition to having a high reflectivity at 500eV, the reflector must transmit the high-energy X-rays efficiently, so as not to interfere with the main instrument. The proportional counter will use charge division to sense position in one dimension, and will contain anti-coincidence anodes to reject background events. The BRP will make polarization measurements by measuring the intensity of observed radiation as the spacecraft rotates around the telescope axis. The primary use for low energy polarization measurements is to fix the inclination angle of the accretion disks of black holes.

H2.00009 Energetics of Non-thermal Accelerated Electrons and Thermal Plasma during Solar Flares  CHRISTOPHER MOORE, University of Iowa, BRIAN DENNIS, NASA Goddard Space Flight Center, UNIVERSITY OF IOWA/NASA GODDARD SPACE FLIGHT CENTER COLLABORATION\(^2\) — Since the beginning of its operation on February 12, 2002, the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) has observed numerous solar flares. RHESSI measures the solar flux from 3 keV (soft X-rays) to 17 MeV (gamma rays) with 1 keV spectral resolution. Assuming a thick-target flare model, energy estimations of the non-thermal accelerated electrons and the plasma at the thermal peak can be obtained through spectral and image analysis. This model is composed of an exponential with an average temperature for the thermal component and a single delta function power law for the non-thermal component. Energy estimations have been carried out for over 30 flares from solar cycle 24.

\(^2\)Summer Internship

H2.00010 The Origin of Stellar Rotation  STEWART BREKKE, Northeastern Illinois University (former grad student) — In the early universe stellar cores were formed primarily in the galactic and pre-galactic arms. These cores were made up of a dense hydrogen mass primarily which were slowly rotating. Orbiting these large hydrogen cores were dense concentric rings of primarily hydrogen gas moving at a relatively fast rate. As the orbits of the rings decayed due to gravitational attraction, the rings of orbiting hydrogen matter tangentially collided and adhered to the pre-formed stellar core transferring the faster orbital angular momentum of the rings to the stellar cores resulting in a faster rotating stellar bodies which over time began to rotate differentially due to internal forces from stellar burning.

H2.00011 Field-free molecular alignment for studies using x-ray pulses from a synchrotron radiation source  PHAY HO, Argonne National Laboratory, MICHELLE MILLER, Northwestern University, ROBIN SANTRA, Argonne National Laboratory and University of Chicago — A short, intense laser pulse may be employed to create a spatially aligned molecular sample that persists after the laser pulse is over. We theoretically investigate whether this impulsive molecular alignment technique may be exploited for experiments using x-ray pulses from a third-generation synchrotron radiation facility. Using a linear rigid rotor model, the alignment dynamics of model molecular systems with systematically increasing size is calculated utilizing both a quantum density matrix formalism and a classical ensemble method. For each system, the alignment dynamics obtained for a 95-ps laser is compared to that obtained for a 10-ps laser pulse. The average degree of alignment after the laser pulse, as calculated quantum mechanically, increases with the size of the molecule. This effect is quantitatively reproduced by the classical calculations. The average degree of impulsive alignment is high enough to induce a pronounced linear dichroism in resonant x-ray absorption using the intense 100-ps x-ray pulses currently available. However, for structural studies based on elastic x-ray scattering, bright x-ray pulses with a duration of 1 ps or shorter will be required in order to make full use of impulsive molecular alignment.

H2.00012 Role of surface band structures in the survival of anions scattered off plane and nano-stepped surfaces

H2.00013 Decomposition based recovery of absorbers in turbid media

H2.00014 Monte Carlo simulations of turbid media

H2.00015 Cooling and Near-equilibrium Dynamics of Atomic Gases across the Superfluid-Mott Insulator Transition

H2.00016 Training Ultrafast Laser Pulses

H2.00017 Progress Towards Scalable Quantum Manipulation using Two Atomic Species in Independent Optical Lattices

H2.00018 Self Organization in the Solar Corona and Interstellar Medium

1 Supported by the NSF, Research Corporation and ISU Honors Program.

2 This work was supported by Research Corporation, National Science Foundation award PHY-0653598 and the Chemical Sciences, Geosciences, and Biosciences Division, Office of Basic Energy Science, US Department of Energy.
The presence of spin-orbit coupling we obtain the expected quadratic dispersion relation for spin waves in long wave-length approximation: however, the spin-wave gas (in the weak coupling limit, this reduces to the RKKY model). By solving the coupled equation of motion for the itinerant and localized electron spins in the Fermi liquid approach in the scattering time calculation. Electron-electron scattering times and spin relaxation times are compared to previous work, as well as polarization decay times in semiconductors. We extend previous theoretical calculations of D’yakonov-Perel’ spin relaxation based on electron-(electron, impurity, hole, phonon) collisions with a careful analysis of the scattering time due to electron-electron collisions in spin-orbit split bands from a fully microscopic approach under typical low temperature III-V semiconductor conditions for 1, 2, or 3 degrees of freedom. In particular, we make use of the classic Abrikosov-Khalatnikov Fermi liquid approach in the scattering time calculation. Electron-electron scattering times and spin relaxation times are compared to previous work, as well as applied to a recent experimental study on spin polarized electron diffusion in GaAs quantum wells. This work was supported by an ONR MURI.

H2.00023 Aharonov-Casher Effect for Spin Waves in a Ferromagnet1, TIANYU LIU, GIOVANNI VIGNALE, Department of Physics and Astronomy, University of Missouri, Columbia — Spin dynamics of an electronic system in the presence of spin-orbit interaction is described in terms of the spin-spin response function. Starting from the double-exchange model in a system consisting of one itinerant electron and two localized ions each of which carries a spin 1/2 we calculate the transverse spin response function of the two localized spins and arrive at a first-principle derivation of the Aharonov-Casher effect on the phase of spin waves in ferromagnetic materials. Next we consider a system of classical localized spins embedded in an electron gas (in the weak coupling limit, this reduces to the RKKY model). By solving the coupled equation of motion for the itinerant and localized electron spins in the presence of spin-orbit coupling we obtain the expected quadratic dispersion relation for spin waves in long wave-length approximation: however, the spin-wave momentum is shifted by a spin-dependent factor in the presence of an electric field. This fact indicates that the spin wave in real space will get a corresponding phase factor under the influence of Aharonov-Casher effect.

1 Work supported by ARO Grant No. W911NF-08-1-0317.

H2.00024 In- and out-of-plane London penetration depths in single crystals of FeSe0.4Te0.6 superconductor1, HYUNSOO KIM, Iowa State University/Ames Laboratory, MAKARIY TANATAR, Ames Laboratory, RYAN GORDON, Iowa State University/Ames Laboratory, CATALIN MARTIN, University of Florida, ZHIQIANG MAO, Tulane University, RUSLAN PROZOROV, Iowa State University/Ames Laboratory — In- and out-of-plane London penetration depths \( \lambda^2(T) \) were measured in single crystals of FeSe0.4Te0.6 superconductor by means of the tunnel diode resonator technique. The penetration depth does not show BCS-like exponential saturation at low temperature. Instead, we found that both \( \Delta \lambda_{ab}(T) \) and \( \Delta \lambda_{c}(T) \) has nearly quadratic behavior, similar to that observed in the FeAs-based superconductors. We also calculated the in-plane superfluid density \( \rho^s(T) = \lambda^2(T)/\lambda^2(T) \), and fitted with various possible models.

H2.00025 The Determination of \( \lambda_{ab}(0) \) in Ba(Fe1-xCox)2As2 from Tunnel Diode Resonator Measurements, RYAN GORDON, HYUNSOO KIM, Iowa State University and Ames Laboratory, CATALIN MARTIN, University of Florida, NICHOLAI SALOVICE, University of Illinois, NI NI, Iowa State University and Ames Laboratory, MAKARIY TANATAR, Ames Laboratory, RUSSELL GIANNETTA, University of Illinois, PAUL CANFIELD, RUSLAN PROZOROV, Iowa State University and Ames Laboratory — The tunnel diode resonator (TDR) technique allows for precision measurements of the change of the London penetration depth with temperature, \( \Delta \lambda(T) \), in superconductors, but before now this approach has been insensitive to the zero temperature value, \( \lambda(0) \), which is necessary for absolute calibration. A method for the determination of \( \lambda(0) \) in superconductors has been developed that utilizes the capabilities of the TDR system along with a technique in which samples are coated with a thin film of aluminum [1]. Using this procedure, \( \lambda_{ab}(0) \) has been measured for the Ba(Fe1-xCox)2As2 series for superconducting samples ranging from underdoped to overdoped concentrations. The resulting temperature dependence of the superfluid density, \( \rho_s = [\lambda(0)/\lambda(T)]^2 \), constructed from penetration depth measurements also obtained using a TDR system, will be discussed in terms of current theoretical models. [1] R. Prozorov et al., Appl. Phys. Lett. 77, 25 (2000).
H2.00026 Manipulation of Dopants in a Two Dimensional Matrix, TIMOTHY KIDD, LAURA STRAUSS, POLINA SKIRTSCHENKO, DUSTIN KLEIN, University of Northern Iowa — The layered dichalcogenides can be used as a matrix for incorporating and manipulating dopants in dimensionally constrained manner. The crystal structure of the dichalcogenides is formed of two-dimensional strongly bound layers separated by a van der Waals gap. Dopants can be incorporated between the layers as intercalants through a variety of methods to form a semi-ordered phase. These intercalants have a strong impact on the electronic and magnetic properties of the overall system and can be used to tune or enhance novel phase transitions found in the pure parent compounds. Herein, we discuss how one can manipulate the arrangement of dopants using self-assembled and top-down methods to yield a high level of control over the local electronic and magnetic structure of these materials.

1This project was supported by Battelle and the Iowa Office of Energy Independence 09-IPF-11.

H2.00027 Determination of polaron hopping frequency limits in modified vanadate and lithium borovanadate glass systems from EPR line-narrowing, J. MCKNIGHT, K. WHITMORE, B. BUNTON, William Jewell College, S. FELLER, D. VENNERBERG, Coe College, B. BAKER, William Jewell College, WILLIAM JEWELL COLLEGE COLLABORATION — Electron Paramagnetic Resonance (EPR) spectra of four different vanadate glass systems of varying molar ratios, R, show that the hyperfine structure lines (hfs) become more resolved and defined as R increases. For example, in the sodium oxide vanadate glass system, RNa2O2V2O5, low R-values (around 0.1) result in little to no hyperfine resolution in the EPR spectra. However, as the R-value increases and approaches 0.5, the spectra significantly become more resolved, and a dramatic narrowing of the lines occurs, revealing a hyperfine coupling parameter B of order 17.7 mT, corresponding to an upper-limit polaron hopping frequency of 467 ± 20 MHz. In the model proposed here, this narrowing is due to an increase in hopping time for polarons associated with V4+ ions. By similar analyses, the systems of RCaOV2O5, RBaOV2O5, and RLi2OV2O5 exhibit comparable polaron hopping frequency limits of 480 ± 20 MHz, 469 ± 20 MHz, and 468 ± 20 MHz, respectively, when R is near 1.0. Data taken at various temperatures ranging from room temperature to 4.2 K reveal that EPR spectra linewidths are not dependent upon temperature.

H2.00028 Study of the structure and oxygen storage/release capacities of Dy1−xYxMnO3+δ (0 ≤ x ≤ 1), STEVEN REMSEN, BOGDAN DABROWSKI, OMAR CHMAISSEM, STANISLAW KOLESNIK, JAMES MAIS, Northern Illinois University, DeKalb, IL 60115, NIU LABORATORY FOR MATERIAL DESIGN TEAM — Synthesis, oxygen storage/release capacities (OSC), oxygen absorption/desorption rates, and preliminary structural properties of Dy1−xYxMnO3+δ (0 ≤ x ≤ 1) have been studied by x-ray and neutron powder diffraction, dilatometry, and thermogravimetric analysis. This system has been found to have excellent reversible OSC at low-temperatures of 200 - 375 °C and oxygen content of these structures have also been found to be sensitive to changes of partial-presures of oxygen in this low-temperature range, making them potential candidates for oxygen sorbents in novel gas separation methods such as thermal swing absorption and thermal-automatic recovery processes. The OSC of the Dy1−xYxMnO3+δ system relies on the difference in oxygen content of a reversible phase transition between hexagonal P63mc (δ = 0) and a previously unreported phase of this system (δ = 0.25, currently under investigation) and pyrochlore Fd3m (δ = 0.50, Subramanian et al. J. Solid State Chem. 72 (1988) 24).

1Work supported by the NSF-DMR-0706610.

H2.00029 Construction of an Inexpensive Scanning Tunneling Microscope for Undergraduate Laboratories, PAUL GARCIA, Doane College, JUSTIN NITZ, University of Nebraska - Lincoln, MARK PLANO CLARK, Doane College, AXEL ENDERS, University of Nebraska - Lincoln — Our goal is to produce an inexpensive, room-temperature, atmospheric-pressure scanning tunneling microscope (STM) with atomic resolution. Our prototype uses slip-stick motion for coarse approach to the surface to be imaged. Motion of the tip is accomplished with four flat piezoelectric translators that provide both z-motion (slip-stick and feedback control) as well as the x-y scanning motion. Maximum x-y scan range is estimated to be about 570 nm and the fine z-motion range is estimated to be about 4.2 K reveal that EPR spectra linewidths are not dependent upon temperature.

H2.00030 Lead Silicate Glasses and Neutron Scattering, GLORIA LEHR, Monmouth College, ADAM VITALE, MARIO AFFATIGATO, STEVE FELLER, Coe College, ALEX HANNON, EMMA BARNEY, Rutherford Appleton Laboratory, DIANE HOLLAND, University of Warwick — Lead silicate glasses can be formed with a very large range of lead concentrations. This raises many questions about the structure of the lead silicates. It is believed that at high concentrations, the lead becomes a glass former rather than a modifier. Many studies have been done on lead silicate glasses, and more recently many studies have been performed to better understand the structure of lead glasses especially at high concentrations. All samples were characterized by their transition temperatures and were found to be self-consistent and in accord with the trends from earlier studies. High lead concentration samples were also characterized by their transition temperatures and were found to be self-consistent and in accord with the trends from earlier studies. High lead concentration samples were also characterized by their transition temperatures and were found to be self-consistent and in accord with the trends from earlier studies. High lead concentration samples were also characterized by their transition temperatures and were found to be self-consistent and in accord with the trends from earlier studies. High lead concentration samples were also characterized by their transition temperatures and were found to be self-consistent and in accord with the trends from earlier studies. High lead concentration samples were also characterized by their transition temperatures and were found to be self-consistent and in accord with the trends from earlier studies.

H2.00031 Barium Vanadate Microspheres, SHARI YOSINSKI, LONDON TWEETON, STEVE FELLER, MARIO AFFATIGATO, Coe College — It has been found that many glass powders can form micro- or nanospheres when heated in a flame or by a laser. Much of the research in this area of microspheres has concentrated on making hollow spheres, called microballoons, of silica and borosilicate glasses. Our aim was to create highly porous barium vanadate microspheres for possible future applications in material storage. The surface area of porous spheres would provide a greater amount of bonding surface area for dopants than hollow spheres. Barium vanadate glass with a molar fraction of 0.4 to 0.6 barium oxide was used because this glass is stable and has a high Tg. Size distributions of the spheres were quantified and the extent of sphere formation and porosity was examined using a scanning electron microscope. The size of spheres formed is affected by powder size, drooping method, and flame position. The porosity of the microspheres is affected by flame temperature, time spent in flame, and the material onto which the spheres fall. The greatest porosity was achieved by first heating the glass powder to a low temperature and then immediately sending it through the flames of two MAPP gas torches at approximately 2100°C onto a metal sheet.

1Supported by the National Science Foundation under grant no. DMR 0904615, and by Coe College.

H2.00032 EPR Study of Frontally Polymerized Acrylate Polymer Systems, A. THOMA, A. VALENCIA, B. BAKER, B. BUNTON, William Jewell College, J. POJMAN, V. VINER, Louisiana State University — Trimethylpropane trimethacrylate (TMPTMA), 1,6-hexanediol diacrylate (HDDOA), and trimethylpropane triacrylate (TMPTA-n) were frontally polymerized and analyzed via electron paramagnetic resonance (EPR) spectroscopy. A comparison of radical concentration was performed for individual polymers and copolymers. Samples were mapped down the EPR tube to observe behavior of radicals downs the polymerization front. During the frontal method, a large spike in intensity is observed at the point of initiation. Within a few centimeters, the signal diminishes into a steady state. As the concentration of TMPTMA was increased linearly in mixtures with TMPTA-n, an exponential growth of the radical concentration was observed. This exponential growth was not observed in the TMPTA-n-HDDOA copolymer; increasing the HDDOA concentration led to a linear growth of radical concentration. Frontal polymerization was also compared to bulk polymerization. The bulk method produced a larger number of radicals than the frontal method.

1Supported in part by Research Corporation and by the E.S. Pillsbury Foundation.
H2.00033 Comparison of single junction to multiple-quantum well quaternary GaInAsSb 2.2 μm light-emitting diode . JINHUI TAN, JONATHAN OLESBERG, LEE MURRAY, JOHN PRINEAS, University of Iowa — A strained GaInAsSb/AlGaAsSb multiple-quantum well (MQW) light emitting diode (LED) emitting at 2.2 μm infrared region is investigated. The heterostructure was grown by molecular beam epitaxy and consists of an active region which contains three compressively strained 12nm thick Ga0.63In0.36As0.06Sb0.94 QWs separated by 20nm thick Al0.28Ga0.72As0.05Sb0.95 barrier in a separate confined heterostructure. X-ray diffraction measurement was used to verify the MQW alloy composition. The sample was processed into variable sized surface emitting LEDs. The emission wavelength was measure with spectrophotograph and the electroluminescent power (L) was characterized versus current (I) and voltage (V). A peak emission power of 13mW/mm²/sr from the 200x200μm² LED was observed at room temperature with 3000A/cm² peak drive current density at 1% duty cycle. Compared to the single junction bulk LED, the MQW LED exhibited an increase in the output power from 4.5 to 13mW/mm²/sr. We will also present the analysis of series resistance and the radiative efficiency of these devices.

H2.00034 Excitons in double-walled carbon nanotubes: fluorescent spectrum . BARRY YEH — The fluorescent spectroscopy of the double-walled carbon nanotubes (DWNT) is mapped to the chirality and diameter feature by the result from single-walled carbon nanotubes (SWNT). The transition energy of SWNT’s resonant Raman spectroscopy is applied to categorize DWNT’s chirality and diameters relationship [P.T. Araujo et. al, 2007 ]. The agreement of their energy level distribution will decide whether the fluorescent spectrum can be use to distinguish carbon nanotubes and the different activity between SWNT and DWNT. Not a peak contains two chiralities at one data set. Since DWNT contains two SWNTs, tubes where matched up within a diameter difference of 0.67nm ~ 0.77nm [M. Gao et. al, 2005].

H2.00035 Copy number variation and mutation . BRIAN CLARK, JACOB WEIDNER, KEVIN WABBICK, Illinois State University — Until very recently, the standard model of DNA included two genes for each trait. This dated model has given way to a model that includes copies of some genes well in excess of the canonical two. Copy number variations in the human genome play critical roles in causing or aggravating a number of syndromes and diseases while providing increased resistance to others. We explore the role of mutation, crossover, inversion, and reproduction in determining copy number variations in a numerical simulation of a population. The numerical model consists of a population of individuals, where each individual is represented by a single strand of DNA with the same number of genes. Each gene is initially assigned to one of two traits. Fitness of the individual is determined by the two most fit genes for trait one, and trait two genetic material is treated as a reservoir of junk DNA. After a sufficient number of generations, during which the genetic distribution is allowed to reach a steady-state, the mean number of genes per trait and the copy number variation are recorded. Here, we focus on the role of mutation and compare simulation results to theory.

H2.00036 Dependence of gene copy number variation on reproductive processes . JACOB WEIDNER, KEVIN WABBICK, BRIAN CLARK, Illinois State University — DNA is divided into genes, which are generally thought to come in pairs and code for a trait or part of a trait. Recently, evidence shows that there are multiple copies of a non-trivial number of genes and that the number of copies of some genes varies greatly from individual to individual. The role of fundamental processes including mutation, crossover, and inversion in determining the number of copies of specific genes is not understood. We report on a relationship between these fundamental processes and copy number variation as investigated via a numerical simulation. In the simulation, individuals are modeled by a single strand of DNA consisting of a set number of genes assigned to different traits. Individuals reproduce according to their fitness as calculated with the two most fit genes assigned to one specific trait.

H2.00037 Video Analysis of a Plucked String: An Example of Problem-based Learning1 . CHRISTOPHER D. WENTWORTH, Department of Physics, Doane College, Crete, NE 68333, ERIC BUSE, Children’s Mercy Hospital, Kansas City, MO 64108 — Problem-based learning is a teaching methodology that grounds learning within the context of solving a real problem. Typically the problem initiates learning of concepts rather than simply being an application of the concept, and students take the lead in identifying what must be developed to solve the problem. Problem-based learning in upper-level physics courses can be challenging, because of the time and financial requirements necessary to generate real data. Here, we present a problem that motivates learning about partial differential equations and their solution in a mathematical methods for physics course. Students study a plucked elastic cord using high speed digital video. After creating video clips of the cord motion under different tensions they are asked to create a mathematical model. Ultimately, students develop and solve a model that includes damping effects that are clearly visible in the videos. The digital video files used in this project are available on the web at http://physics.doane.edu.

1 NSF DUE grants 0088780 and 0088712

H2.00038 Determination of Particle Shape Distributions of Mineral Dust Aerosols Using Spectroscopic and Light Scattering Measurements . BRIAN MELAND, University of Iowa, PAULA HUDSON, California State University, Fullerton, VICKI GRASSIAN, MARK YOUNG, PAUL KLEIBER, University of Iowa — Atmospheric aerosol play a significant role in the Earth’s atmosphere through scattering and absorption of incoming solar radiation as well as outgoing IR terrestrial radiation. Optical remote sensing techniques are often used to estimate aerosol loading, composition, and size distributions. However, these techniques are dependent on an accurate knowledge of the optical properties of the aerosol, which are dependent on the aerosol composition and particle shape. In this work we measure the light scattering phase functions, linear polarizations, and the IR absorption of atmospherically relevant mineral dust aerosol. We explore the possibility of using IR spectral line profiles to infer mineral aerosol particle shape distributions which can then be used in T-Matrix calculations of the phase function and polarization of the scattered light. This has allowed for better agreement with the experimentally measured scattering than was obtained using a more limited range of particle shapes. This research aims to reduce uncertainties in remote sensing measurements by allowing for an independent check of particle shapes.

H2.00039 Monte Carlo simulation study of simple two-dimensional systems . MICHAEL HUGHES, Grinnell College — The relationship between the two-particle interaction potential in a system and the macroscopic observables that result is a key issue in statistical mechanics. To explore this relationship, Monte Carlo simulations are performed on a variety of two-dimensional systems including hard disks and a 2-D Lennard-Jones system. For hard disks, we were not able to confirm the prediction that there is a phase transition containing a region where the pressure is constant with increasing density, although there is evidence that a solid forms under certain conditions as expected. We are also able to produce a pressure-density plot at a constant temperature for the Lennard-Jones model, which shows evidence of a fluid-solid phase transition around kT/ε = 0.82. Also, Monte Carlo calculations are performed directly in the Gibbs ensemble by allowing fluctuations in the volume and particle number, and the phase boundary lines are located more expeditiously than they are by using traditional canonical ensemble Monte Carlo calculations.

H2.00040 A Novel Approach to Computational Protein Folding1 . MOLLY BALL, BRITTANY SHANNON, CHRISTOPHER FASANO, Monmouth College — Protein function is controlled by the shape of the folded protein, so computing the shape of a folded protein is a critical part of understanding how proteins work and how they might be engineered to function in particular ways. We present preliminary results from a novel way of computing protein structure. We take the position that this problem should be treated quantum mechanically and we present applications of techniques from low energy nuclear physics (VCM and GFMC) to this problem. We discuss potential strengths and weaknesses of this approach given our early experiences in computing simple structures.

1Supported by TeraGrid via TeraGrid Pathways Fellowship.
H2.00041 Stellar Coronal Physics with VLBI Imaging, WILLIAM PETERSON, ROBERT MUTEL, University of Iowa — We present the results of synoptic high-resolution imaging studies of two active binary star systems. Both were conducted using the VLBA-HSA at 15 GHz, making them the first images of extrasolar stars capable of discerning structure at scales smaller than a stellar diameter. Images revealed a giant coronal loop on Algol, filled with gyrosynchrotron flux at high activity levels and emitting from only the feet of the loop during quiescent epochs. UX Ari displays similar activity levels to Algol, but the components do not fill their Roche Lobes, making it an optimal comparison case for the role of mass transfer in the formation of global magnetic fields.

H2.00042 Mechanical Deformation of Single- and Few- Layer Graphene on Micro-Scale-Grooved PDMS, DAVID ROCKLIN, SCOTT SCHARFENBERG, CESAR CHIALVO, RICHARD WEAVER, PAUL GOldbART, NADYA MASON, University of Illinois at Urbana-Champaign — The physical properties of the material graphene are currently of wide interest. To explore their mechanical aspects, we placed graphene flakes, of thicknesses ranging from one to seven layers, on a rubbery PDMS (polydimethylsiloxane) substrate containing microgrooves. We used Atomic Force Microscopy (AFM) imaging techniques to study the resulting deformations of the surface, and found that the graphene adhered to the sample and substantially flattened the profile of the grooves. We have examined this flattening effect within a model based on linear elasticity theory. Thus, we have been able to identify, at least tentatively, the point at which shear stress breaks the interlayer coupling and causes the graphene layers to slide against each other.

This work was supported by the DOE-DMS under Award No. DE-FG02-07ER46453, through the Materials Research Laboratory and Center for Microanalysis of Materials (DE-FG02-07ER46453) at UIUC and by the NSF under Award No. DMR-0644674.

Friday, November 13, 2009 5:50PM - 6:20PM –
Session J1 Physics Demonstrations by the Univ. of Iowa SPS Students, Univ. of Iowa and the Iowa Chapter of the AAPT Van Allen Hall LR1 - Dale Stille, IAAPT and University of Iowa

5:50PM J1.00001 Demonstrations –

Friday, November 13, 2009 6:20PM - 7:05PM –
Session K1 Plenary Session II Van Allen Hall LR1 - Robin Santra, Argonne National Laboratory

6:20PM K1.00001 The Sounds of Space, DONALD GURNETT, University of Iowa — The popular concept of space is that it is a vacuum, with nothing of interest between the stars, planets, moons and other astronomical objects. In fact most of space is permeated by plasma, sometimes quite dense, as in the solar corona and planetary ionospheres, and sometimes quite tenuous, as is in planetary radiation belts. Even less well known is that these space plasmas support and produce an astonishing large variety of waves, the “sounds of space.” In this talk I will give you a tour of these space sounds, starting with the very early discovery of “whistlers” nearly a century ago, and proceeding through my nearly fifty years of research on space plasma waves using spacecraft-borne instrumentation. In addition to being of scientific interest, some of these sounds can even be described as “musical,” and have served as the basis for various musical compositions, including a production called “Sun Rings,” written by the well-known composer Terry Riley, that has been performed by the Kronos Quartet to audiences all around the world.

Friday, November 13, 2009 7:15PM - 9:00PM –
Session L1 Banquet (7:15 - 9:00 PM) IMU 243 (Ballroom) -

7:15PM L1.00001 BANQUET –

Saturday, November 14, 2009 8:30AM - 9:42AM –
Session N1 Particle Physics III IMU 348 (Illinois Room) - Robert Zwaska, Fermi National Accelerator Laboratory

8:30AM N1.00001 Much Ado About (Almost!) Nothing: The Experimental Study of Neutrino Masses and Mixing, MARK MESSIER, Indiana University — Neutrinos have been described by their discoverer Frederick Reines as “the most tiny quantity of reality ever imagined by a human being.” Yet these particles which verge on nothingness have had an enormous influence on the past and future evolution of the universe and are the subject of an increasingly active program of experimental physics. In this talk I will review some of the basic properties of neutrinos and summarize the recent results on neutrino masses and mixing from studies of neutrinos produced in the Sun, cosmic rays, reactors, and accelerators including searches for zero neutrino double beta decay. Looking ahead, I will outline the future course of experiments in the U.S., Asia, and Europe which will address the questions of the fundamental character of the neutrino, the hierarchy of their masses, and their matter anti-matter symmetries.

9:06AM N1.00002 R&D Studies on Radiation Hard Wavelength Shifting Fiber for CMS Hadronic Endcap Calorimeter Upgrade, JOHN NEUHAUS, University of Iowa — The Hadronic Endcap (HE) calorimeters of the CMS experiment cover the pseudorapidity range of 1.4 to 3 on both sides of the CMS detector, contributing to superior jet and missing transverse energy resolutions. As the integrated luminosity of the LHC increases, the scintillator tiles used in the CMS Hadronic Endcap calorimeter will lose their efficiency. Here, we propose to replace the scintillator tiles with “radiation hard” quartz plates to increase the efficiency. The generated Cerenkov photons are collected by UV absorbing wavelength shifting (WLS) fibers. Our previous study has shown that quartz plates and plastic wavelength shifting fibers can be used as an effective calorimeter. However there is no radiation hard WLS fiber commercially available. Here we summarize the R&D studies on constructing a radiation hard WLS fiber prototype in University of Iowa CMS Laboratories. The results from the tests performed on quartz fibers treated with p-Terphenyl, as well as the Geant4 simulations of this prototype are presented.
The charge and spin transport and torque for domain walls in a ferromagnetic semiconductor. Under coherent transport conditions, analytic solutions for spin-dependent transmission and reflection coefficients are possible.\cite{1,2}

The velocity is larger for a large nonlinear spin torque is generated over a range of intermediate wall widths, but vanishes for very thin and very thick walls. We calculate the peak domain wall resistance monotonically decreases with width. The spin torque on a \( \pi \) wall is highly nonlinear and insensitive to width, except for very thin walls. In \( 2\pi \) walls, large nonlinear spin torque is generated over a range of intermediate wall widths, but vanishes for very thin and very thick walls. We find the peak domain wall velocity is larger for a \( 2\pi \) wall than a \( \pi \) wall, suggesting unexpected nonlinearities in magnetoelectronic devices incorporating domain wall motion.

\footnote{On behalf of the CMS Collaboration}

\section{Saturday, November 14, 2009 8:30AM - 9:54AM — Session N2 Condensed Matter Physics III}

\subsection{8:30AM N2.00001 Influence of magnetism on phonons in CaFe\(_2\)As\(_2\) as seen via inelastic x-ray scattering \label{N2.00001} }

STEVEN HAHN, YONGBIN LEE, NI NI, PAUL CANNFIELD, ALAN GOLDMAN, ROBERT MCQUEENNEY, BRUCE HARMON, Ames Laboratory and Iowa State University, AHMET ALATAS, BOGDAN LEU, ERCAN ALP, Advanced Photon Source, Argonne National Laboratory, DUCK YOUNG CHUNG, ILIYA TODOROV. Materials Science Division, Argonne National Laboratory, MERCOURI KANATZIDIS, Materials Science Division, Argonne National Laboratory and Department of Chemistry, Northwestern University — In the iron pnictides, the strong sensitivity of the iron magnetic moment to the arsenic position suggests a significant relationship between phonons and magnetism. We measured the phonon dispersion of several branches in the high-temperature tetragonal phase of CaFe\(_2\)As\(_2\) using inelastic x-ray scattering on single-crystal samples. These measurements were compared to \textit{ab initio} calculations of the phonons. Spin-polarized calculations imposing the antiferromagnetic order present in the low-temperature tetragonal phase dramatically improve agreement between theory and experiment. This is discussed in terms of the strong antiferromagnetic correlations that are known to persist in the tetragonal phase.

\subsection{8:42AM N2.00002 Analyzing Magnetic Molecules Using TDR \label{N2.00002} }

STEVEN YENINAS, RUSLAN PROZOROV, MARSHALL LUBAN, Iowa State University/Ames Laboratory — Since the early nineties, much interest has grown in the field of magnetic molecules due to the fact that at suitable low temperatures, intermolecular interactions can be ignored. As a result, studying crystalline samples can be reduced to analyzing the discrete spectrum of magnetic energy levels within an individual molecule. As the size and complexity of magnetic molecules continues to grow, we see that low temperature DC magnetization measurements are restricted to regions of ground state level crossings, demanding a more detailed experimental technique. However, using a tunnel diode resonator (TDR) to measure the dynamic magnetic susceptibility in the millikelvin range, we can probe the magnetic spectrum in both the ground state and low-lying excited states. The TDR technique has recently been used to investigate the magnetic molecules Cr\(_2\)Cu\(_2\) and Cr\(_{10}\)Cu\(_2\). When compared with theoretical quantum Monte Carlo (QMC) simulations, we find the TDR results to be in excellent agreement with the predicted energy spectrum. This demonstrates that the QMC model can be a valuable quantitative tool for analyzing the magnetic spectrum.

\subsection{8:54AM N2.00003 Exchange-correlation energy functionals for electrons in two dimensions \label{N2.00003} }

STEFANO PITTALIS, University of Missouri, E. RÅ¸ÄNEN, University of Jyväskylä, Finland, C. PROETTO, Free University Berlin, Germany, M. MARQUES, CNRS, Universite Lyon 1, France, E.K.U. GROSS, Max-Planck-Institut fuer Mikrostrukturphysik, Halle, Germany — Two-dimensional (2D) electronic systems have attracted vast interest since the beginning of semiconductor technology. The investigation of electronic properties of these 2D structures form a significant part of condensed matter and materials physics research. Among the available theoretical and computational methods to deal with many-electron systems is the density-functional theory (DFT). The fundamental quantity in DFT is the exchange-correlation (xc) energy functional, which embodies all the effect of the electron-electron interactions. In practice, this functional needs to be approximated. Many approximations have been developed for three-dimensional (3D) systems, where considerable advances beyond the commonly used local spin-density approximation (LSDA) were achieved. Unfortunately, most of the popular 3D approximations are inadequate for 2D systems. Hence, there is a clear need for new approximations specifically developed for 2D systems. Following this important need, efficient and practical expressions for the xc-energy of electrons in 2D are presented. Numerical results for finite systems show that the proposed functionals outperform the standard 2D LSDA.

\section{9:06AM N2.00004 Spin torque and charge resistance of ferromagnetic semiconductor \( 2\pi \) and \( \pi \) domain walls \label{N2.00004} }

E.A. GOLOVATSKI, M.E. FLATTÉ, OSTC and Dept. of Physics and Astronomy, University of Iowa — Charge resistance and spin torque are generated by coherent carrier transport through ferromagnetic \( 2\pi \) domain walls, but with qualitatively different trends than for \( \pi \) walls. We calculate charge and spin transport and torque for \( \pi \) and \( 2\pi \) domain walls in a ferromagnetic semiconductor. Under coherent transport conditions, analytic solutions for spin-dependent transmission and reflection coefficients are possible.\cite{1,2} The \( 2\pi \) wall resistance has a maximum at an intermediate wall width; the \( \pi \) wall resistance monotonically decreases with width. The spin torque on a \( \pi \) wall is highly nonlinear and insensitive to width, except for very thin walls. In \( 2\pi \) walls, large nonlinear spin torque is generated over a range of intermediate wall widths, but vanishes for very thin and very thick walls. We find the peak domain wall velocity is larger for a \( 2\pi \) wall than a \( \pi \) wall, suggesting unexpected nonlinearities in magnetoelectronic devices incorporating domain wall motion.

\footnote{P. Levy and S. Zhang, PRL 79, 5110 (1997)}
\footnote{G. Vignale and M. E. Flatté, PRL 89, 098302 (2002)}
9:18AM N2.00005 Coulomb drag and spin Hall Drag\footnote{This work is supported by a US Department of Energy grant} - GIOVANNI VIGNALE, University of Missouri — Double-layer structures consisting of two parallel quantum wells separated by a potential barrier are an important class of nanoscale electronic devices. Each layer hosts a quasi-two dimensional electron gas and electrons interact across the barrier via the Coulomb interaction. When an electric current is driven in one of the layers the Coulomb interaction causes a charge accumulation in the other layer. This phenomenon, known as Coulomb drag, is of fundamental interest as a probe of electron correlations. Another effect of great interest is the Spin Hall Effect, i.e. the generation of spin accumulation by an electric current. This is due to spin-orbit interactions and has recently received great attention not only because of its theoretical subtlety but also for its usefulness as a source of spin-polarized currents. In this talk I describe a new effect, which arises from the combination of spin Hall effect and Coulomb drag. I call it Spin Hall Drag. The effect consists in the generation of transversal spin accumulation in one layer by an electric current in the other layer. Microscopic calculations indicate that the induced spin accumulation, although considerably smaller than the one observed in the ordinary spin Hall effect, is large enough to be detected in optical rotation experiments.

In collaboration with Samvel Badalyan, University of Regensburg.

\footnote{Work supported by NSF Grant No. 0705460.}

Saturday, November 14, 2009 10:30AM - 11:30AM – Session P1 Particle Physics IV IMU 348 (Illinois Room) - Robert Zwaska, Fermi National Accelerator Laboratory

10:30AM P1.00001 Mesons From String Theory\footnote{Presenter} - KORY STIFFLER, The University of Iowa — After a brief historical synopsis of the connection between gauge theories and string theory is discussed, meson configurations known as k-strings will be discussed. K-strings can be examined from string theory via the gauge/gravity correspondence. Backgrounds dual to k-strings in both 2 + 1 and 3 + 1 will be discussed. The energy of k-strings to lowest order consists of a tension term, proportional to the length, L, of the k-string, i.e., the size of the mesons in the configuration. The first quantum correction is a Coulombic 1/L correction, known as a Lüscher term, plus a constant. Acquiring tensions and Lüscher terms via the gauge/gravity correspondence will be discussed.

10:42AM P1.00002 A data driven method to estimate high MET tail in QCD events\footnote{Presenter} - ELIF ASLI ALBAYRAK, University of Iowa, CMS COLLABORATION — High pt multijet events with large missing energy is one of the important signature that will be used for supersymmetry discovery at LHC. Applying various analysis requirements in a cut-based study can reduce many Standard Model backgrounds. This channel, however, is vulnerable to fake missing energy that comes from mismeasured jets. Especially events which are produced by QCD processes will have fake missing energy, and rate of such events will be very high due to QCD cross-section. Even after optimized analysis cuts, QCD events will remain as a substantial background to this channel. In the early phases of LHC, studies based on Monte Carlo to estimate the fake missing energy from QCD events will not be reliable, thus, the use of data driven methods are imperative. In this talk we will present an estimation method for large missing transverse energy events in QCD background based on data for SUSY multi-jet and missing energy. This method is based on missing transverse energy projection fraction where mismeasured jet and low missing transverse momentum vectors are used to estimate high tail in missing transverse energy.

10:54AM P1.00003 Directly Coupled Tiles for a High Granularity Scintillator-SiPM Calorimeter - PATRICK SALCIDO, Northern Illinois University — Future detectors in high energy particle physics, such as those being proposed for the International Linear Collider (ILC), will require highly segmented hadron calorimetry. One goal in the design of such devices is to improve the jet energy resolution in order to separate Z and W decays into jets. One of the technologies being explored is using small scintillator cells in conjunction with silicon photo multipliers (SiPM) as photon sensors. This talk will present the status of the research being performed on this by the Northern Illinois University High-Energy Physics group in collaboration with Fermilab and the CALICE Collaboration. It will include results on the geometry used to directly couple the cells to the photo detectors, and the design and operation of the circuit board and associated electronics used to read out an array of scintillators.

11:06AM P1.00004 A High Precision Measurement of $\theta_{13}$ with the Daya Bay Antineutrino Detectors - BRYCE LITTLEJOHN, University of Wisconsin - Madison, DAYA BAY COLLABORATION — The Daya Bay Reactor Neutrino Experiment is being built to measure short-baseline electron antineutrino disappearance at the Daya Bay nuclear reactor complex in southern China. Eight antineutrino detectors placed at different distances from the reactor cores will measure antineutrino flux and energy spectrum via inverse beta decay reactions on protons. Using this information, the experiment aims to identify the final neutrino mixing angle $\theta_{13}$ with a sensitivity of $\sin^2 2\theta_{13} < 0.1$ at 90% CL. As the Daya Bay sensitivity will ultimately be limited by detector-related systematics, understanding detector performance and identicalness will be crucial to meeting experimental goals. This talk will present the physics principles used in and the design of the detectors, the expected detector performance, an explanation of AD systematics, and the current status and future plans of the experiment.

11:18AM P1.00005 SUSY Searches at ATLAS in Di-jet and Multi-jet Channels Using Alternatives to Missing Transvers Energy\footnote{Presenter} - RISHIRAJ PRAVANAH\textsuperscript{2}, KAUSHIK DE, Univ. of Texas at Arlington, ATLAS COLLABORATION — We investigate the possibilities of discovering Supersymmetry (SUSY) in the di-jet and multi-jet channels using the ATLAS detector at the LHC with $\sqrt{s} = 10$ TeV. This analysis investigates alternatives to reconstructed missing transverse energy ($E_T^{\text{miss}}$) as the signature for LSP production in SUSY events, since ($E_T^{\text{miss}}$) may be difficult to measure accurately during early data taking. Such alternative techniques of constructing kinematic variables can be used to search for new physics channels that produce jets and weakly interacting stable particles. We explore a number of kinematic variables to study the discovery significance for various SUSY models with $200pb^{-1}$ of integrated luminosity. In this talk I would like to present the work we have done towards the goal to study and understand if any one or combination of these variables can be used in place of, or in conjunction with $E_T^{\text{miss}}$, to yield better discovery significance.

\textsuperscript{1}This work is supported by a US Department of Energy grant.
10:30AM P2.00001 Magnetic losses, critical currents and pinning in coated conductors1. ANOTA IJADUOLA, Monmouth College, JAMES THOMPSON, DAVID CHRISTEN, R. FEENSTRA, A. Goyal, C.L.H. THIEME, K.R. MARKEN — The discovery of high temperature superconductors (HTS) in particular YBa2Cu3O7−δ (YBCO) (Tc ≈ 92 K), sparked great interest in the use of HTS materials in practical applications such as transmission lines, motors and generators. Different techniques are used to fabricate these ‘coated conductors’ from YBCO and other HTS. Ferromagnetic losses arise from the substrates that are used in the fabrication processes. I will talk about the studies we have done on these losses and also discuss the critical current (Ic) that flow in these coated conductors. On the other hand, exposing a type II superconductor to magnetic field generates vortices which are detrimental to the current carrying capabilities. These vortices have to be pinned (made immobile) in order to have significant and useful Ic flow in these conductors. I will discuss the different pinning mechanisms used in these coated conductors and particularly focus on the pinning features we studied on some set of YBCO thin films.

1Work supported by AFOSR and the USDOE through the ORNL.

10:42AM P2.00002 An unusual way to control the surface doping of cuprate superconductors in Angular Resolved Photoemission Spectroscopy (ARPES) experiments. ARI D. PALCZEWSKI, TAKESHII KONDO, A. KAMINSKI, Ames Laboratory and Department of Physics and Astronomy, Iowa State University, Ames, IA 50011, USA, G.Z.J. XU, G. GU, J.S. WEN, Condensed Matter Physics and Materials Science Department, Brookhaven National Laboratory, Upton, New York 11973, USA — We study the variation of the electronic properties at the surface of a high temperature superconductor Bi2Sr2CaCu2O8+δ (Bi2212) as a function of vacuum conditions in angle resolved photoemission spectroscopy (ARPES) experiments. Normally, under less than ideal vacuum conditions the carrier concentration of (Bi2212) increases with time due to the absorption of oxygen from CO2 and CO molecules that are prime contaminants present in ultra high vacuum (UHV) systems. We find that in a high quality vacuum environment at low temperatures, the surface of Bi2212 is quite stable (the carrier concentration remains constant), however at elevated temperatures the carrier concentration decreases due to the loss of oxygen atoms from the Bi-O layer. These two effects can be used to control the carrier concentration in-situ. Allowing us to probe the doping phase diagram of cuprates on a single sample. Support: Department of Energy DE-AC02-07CH11358 & DE-AC02-98CH10886 and National Science Foundation DMR-0537588

10:54AM P2.00003 Structured illumination for stress reduction gloss reduction and 3 dimensional patterning of photopolymers1. CHRIS CORETSSOPOULOS, PETER GANAHL, ALEC SCRANTON, University of Iowa — “Structured illumination” method is based upon a two-stage illumination process in which a photoactive polymer is first illuminated in a pattern of light and dark regions. During this structured illumination stage, unreacted monomer from the dark region will migrate in response to the polymerization and the resulting shrinkage thereby preventing the development of stress. At the end of the structured illumination stage, the system contains patterned regions of stress-free polymer among pools of unreacted monomer. After a specified duration of structured illumination, the second, flood cure, stage begins. Here the entire system is illuminated to achieve a consistently high conversion throughout the coating. Experimental results confirm that over 90% of the polymerization shrinkage stress can be eliminated using this approach. A further benefit of this method is the production of 3 dimensional curved objects that can be photo-patterned with simple mask structures. This is in contrast to steep walled structures produced by conventional photolithography. The resulting polymer has been used to reduce gloss in surface coatings without the need of using additives, and to make micro scale 3D features and optical elements and microstructures.

1Support from IUCRC for fundamentals of photopolymerization.

11:06AM P2.00004 Characterization of Large-Core Photonic Bandgap Fibers for Spectrally Broad Visible Light Transmission1. E. SCHIAVONE, Carthage College, A. STOLYAROV, Y. FINK, PHOTONIC BANDGAP FIBERS AND DEVICES GROUP TEAM — Snell’s law imposes a fundamental limitation on the transmission efficiency of randomly directed, broadband fluorescence signals through solid core fibers. On the other hand, guiding light through an air core fiber clad with perfect mirrors would make possible perfect collection of broad and coherent light. However, there is a fundamental limitation on the diameter of a perfect mirror for practical reasons. Approaching this idealization, hollow core photonic bandgap fibers offer a flexible, light weight and concealable platform for diffuse light transport and remote chemical sensing applications. While in the small core regime, these fibers possess discrete modal properties, larger core PBG fibers have the advantage of better collection efficiencies for ambient analyte sensing and are expected to have lower losses arising from a smaller overlap of the core field with the cladding. Therefore, large-core (~300 micron) visible transmission fibers are characterized, with cutback measurements, in order to determine the achievable transmission efficiency of these fibers along with the optimal materials and geometries for the production of optical devices that propagate light from a diffuse broadband light source. These measurements conclude that larger cores exhibit lower losses in transmission than smaller cores constructed despite a more ideal mirror.

1I would like to thank the CMSE REU Program, as part of the MRSEC Program of the NSF and the MIT Materials Processing Center.

11:18AM P2.00005 Synchrotron Radiation Studies of Environmental Materials, DANIEL OLIVE, JEFF TERRY, Illinois Institute of Technology — In the case of environmental contaminants, the mobility of elements changes depending on oxidation state. Remediation techniques often focus on changing the oxidation state in order to immobilize, by forming an insoluble species, or removing by binding a soluble species to an insoluble material. In order to accomplish this immobilization one has to understand all the possible reactions that can change the oxidation state. One of the techniques that can be used to determine the oxidation state and local atomic structure of environmental contaminants under aqueous conditions is X-ray absorption spectroscopy (XAS). Synchrotron radiation was used to excite the absorption edges of As, Tc, and Pu, in order to characterize their oxidation states and structures under environmentally relevant conditions. Granular activated carbon treated with iron has shown promise for the removal of arsenic from contaminated ground water, where XAS measurements have determined that the arsenic bound to iron oxide as $\text{AsO}_4^{3-}$. Pertechnetate ($\text{TcO}_4^{-}$) was found to be reduced to $\text{TcO}_2$ in a reaction with amorphous iron sulfide (FeS). Bio-reduction of plutonium has also been studied using bacteria that may be found in nuclear waste repositories resulting in an end product of Pu(III).
11:42AM Q1.00002 Diffeomorphisms as a Source of the C.M.B. Anisotropy, CHRISTOPHER DORAN, KORY STIFFLER, VINCENT RODGERS, University of Iowa — The diffeomorphism field is a rank-two tensor that naturally arises from the Virasoro algebra. It was suggested by Rodgers and Yasuda that this field has the potential as a candidate for the inflaton in the early universe and appears in the origins of dark energy in cosmology. We are now examining its influence on the C.M.B. anisotropy, which is one of cosmology’s outstanding problems. We consider first-order space-time dependent fluctuations to the Einstein tensor through fluctuations to the metric, diffeomorphism field, and perfect fluid tensor for radiation. The goal is to find appropriate solutions and use them in the CMBFast or CAMB simulations to get a picture of the diffeomorphism field’s contribution to the anisotropy.

11:54AM Q1.00003 The capability of the ALICE detector to measure the production of b-quark containing hadrons, BJORN NILSEN, Creighton University, ALICE COLLABORATION — The production of heavy quarks in the high energy pre-thermal collision between heavy ions can be used as probes to help understand the nature of the later formed Quark Gluon Plasma and the strong force which dominates there. The semi- leptonic decay of $B$ mesons and $C$ baryons have a large enough life-time to allow for improved identification. This in turn allows for the study of the effects of the QGP on the properties of the $b$-quark’s. An analysis is being developed, based on simulations, to determine the feasibility of such a measurement. Results from this analysis will be presented.

12:06PM Q1.00004 Atom Wavelike Nature Resolved Mathematically, CHARLES SVEN, Author: “The 21st Century’s All New Cosmology” — Like N/S poles of a magnet the strong force field surrounding, confining the nucleus exerts an equal force [noted by this author] driving electrons away from the attraction of positively charged protons force fields in nucleus – the mechanics for wavelike nature of electron. Powerful forces corral closely packed protons within atomic nucleus with a force that is at least a million times stronger than proton’s electrical attraction that binds electrons. This then accounts for the ease of electron manipulation in that electron is already pushed away by the very strong atomic N/S force field; allowing electrons to drive photons when I strike a match. Ageless atom’s electron requirements, used to drive light/photons or atom bomb, without batteries, must be supplied from a huge, external, super high frequency, super-cooled source, undetected by current technology, one that could exist 14+ billion years without degradation – filling a limitless space prior to Big Bang. Using only replicable physics, I show how our Universe emanated from that event.

12:18PM Q1.00005 Quantum Gravity, SHANTILAL GORADIA, Gravity Research Institute — The continuing search for quantum gravity and never ending attempts to unify gravity with other forces of nature represent tremendous waste of public and private funds directing students’ energy towards non-creative manipulative work instead of learning from the scientific creativity in Einstein’s 1919 paper that unifies gravity with nuclear force. It reflects Einstein’s 1919 jump beyond his own 1915 theory of gravity, including that of Newton as implicitly demanded by Newton in 1686. Einstein corrected and retracted his 1917 introduction of cosmological constant in 1919. Dislike of the fact that Einstein did not use quantum mechanics to prove his point has no real value now, because we will use key ingredients (Planck scale and probabilistic aspect) of quantum mechanics and show that they reach the same conclusion. Newton explained the solar system known after Kepler. Likewise, our quantum mechanical approach explains the strong coupling as well the solar system and shows new horizons, otherwise unexplained. Explanation of unexplained observations need no prediction per Hawking, and obviously otherwise.

12:30PM Q1.00006 A Physical Model of the Metric Expansion of Space, JOHN LAUBENSTEIN, IWPD Research Center, Inc. — At the heart of IWPD’s Scale Metrics (ISM) theory is the realization that any orthogonal relationship may be equivalently expressed as a linear relationship multiplied by a mathematical scalar. This has significance in the relationship of a worldline to its 4-Velocity and observed 3-Velocity, as well as in understanding the divergence between energy and momentum as invariant mass increases. Spacetime may be depicted by taking the time dimension within four-dimensional spacetime and rotating it until it becomes embedded as a line segment (or ring) within the three spatial dimensions. This allows velocity and momentum to be determined based upon a linear subtraction of physical entities multiplied by a mathematical scalar (X). We will provide evidence supporting the mathematical and physical significance of this scaling factor along with the benefits of ISM theory. This model provides a physical explanation of the metric expansion of space and addresses many of the current challenges in physics. The model makes predictions that are currently testable with technologies already in place.

12:42PM Q1.00007 The Origin of Galactic Rotation, STEWART BREKKE, Northeastern Illinois University (former grad student) — The early universe consisted of many systems of already formed pre-galactic arms, the arms in orbit about each other. As the orbits of the arms decayed due to gravitational attraction, the fore sections of the arms tangentially collided and stuck together forming spiral galaxies. The orbital motion of the pregalactic arms became transformed into rotational motion of the newly formed spiral galaxies. As the rotational motion of the newly formed spiral galaxies slowed down, the spiral arms collapsed into the body of the galaxy forming elliptical galaxies rotating slower than spiral galaxies.

12:54PM Q1.00008 The possibility of a Very High Momentum Particle Identification upgrade for Alice, EDMUNDO GARCIA, Chicago State University — The results of RHIC have strongly altered the perception of the baryon production in heavy-ion collisions. From a proton over pion ratio of 9% in the thermal region, above transverse momenta of 3 GeV/c this ratio equals or even surpasses unity. Several theoretical predictions for LHC assume an enhanced baryon production at higher transverse momenta: 10-20 GeV/c. In that optics we have decided to propose to the ALICE collaboration an upgrade of the particle identification capabilities with a new detector of small size 12 square meters. In the first stage we consider building a prototype to be commissioned at the end of 2011. The prototype would consist of a C4P10 gas Cherenkov detector with spherical mirror focusing, and CsI photocathode coupled with MWPCs. The detector would identify pions and kaons up to a momentum of 26 GeV/c with a 4 sigma separation. We will discuss also the possible use of GEMs as a photo detector where encouraging results have been obtained by our protocollaboration. The physics capabilities of such a detector in conjunction with the ALICE experiment will be contemplated.

Saturday, November 14, 2009 11:30AM - 1:06PM — Session Q2 Physics Education

11:30AM Q2.00001 21st Century Skills and the Physics Classroom, SALLY RIGEMAN, Mississippi Bend Area Education Agency, Bettendorf, IA, PETER BRUECKEN, Bettendorf High School, Bettendorf, IA — What content knowledge and skills will today’s physics students need to acquire to be successful employees in the 21st century? How can today’s physics classrooms prepare students for collaboration in a global work environment? What kind of instruction can engage physics students in learning that supports these demands? Attend this session to find out what motivates today’s Net Generation.
12:06PM Q2.00002 Small Angle Light Scattering from Stretched HDPE: An Experiment for the Advanced Lab, JOHN ZWART, MATTHEW VANDE BURGT, Dordt College — Soft matter physics is an emerging research area. We have developed a desk top experiment, suitable for upper level undergraduates, in which the scattering pattern of HeNe laser light sent through a film of high density polyethylene (HDPE) is investigated. As a film of HDPE is deformed, the changing pattern of the scattered light can be correlated with structural changes of the HDPE.

12:18PM Q2.00003 Interactive Physics Illustrations Using Geometer’s Sketchpad, DALE YODER-SHORT, AAPT — We will show the use of Geometer’s Sketchpad to create and use interactive, dynamic physics illustrations that can be run on PC or Mac computers. These sketches allow the user to change input parameters and instantly see output results of a physical situation. For example the user can create a ray diagram for a lens or mirror and then move the object or change the lens focal length. The illustration will immediately show the resulting image. The user can construct a clock which allows the creation of moving objects in an illustration. So, one can construct an illustration of the motion of an accelerated object or of wave motion or of collisions between two objects. Finally one can construct iterative type illustrations such as the motion of a planet in an elliptical orbit. The sketches show what happens as well as calculate relevant output parameters as the input parameters change. The sketches can be used by the teacher to illustrate a concept or by the student in a computer lab or exploration. These sketches can be as simple or complex as the author wants. They can even be constructed by the student to explore a concept. Geometer’s Sketchpad is not difficult to use and a simple illustration sketch can be constructed in a few minutes.

12:30PM Q2.00004 A Freshman Science Cohort Class for Underprepared Students1, NATHAN MOORE2, JOHN DEMING3, Winona State University — A troubling fraction of students in STEM majors flounder at the introductory level. The most compelling reason for this is a lack of adequate intellectual preparation. On a fundamental level, science is done by thinking critically about the natural world. Students with weak quantitative reasoning skills will struggle in quantitative science fields. The talk will discuss the depth of the problem, a teaching strategy implemented at Winona State University which is designed to enhance these skills, and initial results, indicating a substantial increase in student ability and retention in STEM fields.

1Support from the Minnesota State College and University System
2Department of Physics
3Department of Chemistry

12:42PM Q2.00005 The Bernoulli or Coanda Conundrum and Other Classical Demonstration Myths, DALE STILLE1, IAAPT — Lecture Demonstration professionals have recently taken a closer look at demonstrations that were traditionally labeled “Bernoulli Demonstrations” in most textbooks. This examination has shown that in most cases the Coanda Effect, Magnus Effect, and Entrainment may be better explanations for most of these classic demonstrations. A discussion of other similarly classic demonstrations and some of their problems or misconceptions will also be presented.

1IAAPT member submitting for the co-sponsored APS/IAAPT session

12:54PM Q2.00006 An Energy First Approach to Introductory Physics, CHRISTOPHER WHITE, DANIEL MEYER, KIMBERLY FLUET, Illinois Institute of Technology — While introductory physics texts and curricula vary in scope and sequence, there is one aspect that is particularly stable: the progression that begins with equations of motion, continues through Newton’s Laws, and finally leads to work and energy. While this approach seems reasonable, it can lead to student misconceptions, and is not necessitated by the physics. In particular, it implies that energy is dependent on forces, rather than both being independently definable. In this paper, we discuss taking an Energy First approach, that begins with energy, and utilizes it as the core concept. We address both the pedagogical and conceptual reasons for this approach. Finally, we discuss its use in two introductory courses, one designed for elementary teachers and one designed for architecture majors. In each, we have focused on defining a scope and sequence that is appropriate and meaningful for that audience, rather than continue with a standard, generic approach to introductory physics.