Thursday, October 23, 2008 8:30AM - 12:25PM –
Session 1WA Workshop: Quantifying the Character of the sQGP
Jewett Ballroom FGH

8:30AM 1WA.00001 Heavy Quarks and Quarkonia in Thermal $\text{aAdS}^5$
DEREK TEANEY, Stony Brook University —
I review how heavy quarks lose energy in $\text{aAdS}$/$\text{CFT}$. I further show how the quantum mechanics of a string in $\text{aAdS}$, together with Kruskal structure of $\text{aAdS}$ black holes gives rise to the expected stochastic dynamics of a quasi-particle in a thermal bath. The Kruskal structure is needed to reproduce the dynamics of the quasi-particle on the Schwinger-Keldysh contour. After initially considering a particle at rest I extend the results to quarks moving with finite velocity. With the stochastic dynamics of a fast quark clarified, I compute the rate of induced photon bremsstrahlung associated with the fast heavy quark and compare the results to perturbation theory. Finally I compute the drag of heavy quarkonia in $\text{aAdS}$/CFT and discuss the relevance of these results to heavy ion collisions.

1The author is supported by an OJI grant from the Department of Energy and as a Sloan Fellow.

9:05AM 1WA.00002 Exploring the Lower Limits of Perfection
WILLIAM A. ZAJC, Columbia University —
A fascinating dialectic has emerged between the observation of “perfect liquid” behavior by the RHIC sQGP [1], and the near-simultaneous conjecture of a fundamental bound on the ratio of viscosity to entropy density $\eta/s \geq 1/4\pi$ obtained by Kovtun, Son and Starinets (KSS) [2] via the $\text{aAdS}$/CFT correspondence. While the existence of such a bound was anticipated by Danielewicz and Gyulassy based on simple quantum mechanical arguments [3], the possible connection to those conformal field theories with gravity duals studied by KSS and others makes the determination of the value of $\eta/s$ for the RHIC fluid particularly intriguing. This talk will consider various approaches utilizing flow, fluctuations, heavy quark transport and detailed second-order causal hydrodynamic simulations. The self-consistency, lack thereof, of the resulting values for $\eta/s$ will be discussed, along with prospects for future improved measurements and theoretical analysis.

References

9:40AM 1WA.00003 Quantifying dynamical QCD plasma through jet energy loss
MAGDALENA DJORDEVIC, The Ohio State University —
In order to make reliable quantitative predictions for jet quenching in ultra-relativistic heavy ion collisions, it is necessary to have accurate calculations of energy loss. However, all currently available radiative heavy flavor energy loss studies suffer from a crucial drawback, which is an assumption that a medium is composed of static scattering centers. Since in reality the constituents of the medium are dynamical, it is necessary to include effects of dynamically screened QCD medium in order to obtain reliable theoretical predictions for jet quenching. We calculate, to first order in the number of scattering centers, the energy loss of a heavy quark traveling through a QCD medium consisting of dynamical constituents. We show that the result for a dynamical medium is significantly larger compared to a medium consisting of randomly distributed static scattering centers. Therefore, a quantitative description of jet suppression in RHIC and LHC experiments must correctly account for the dynamics of the medium’s constituents.

This work was supported by U.S. Department of Energy, grant DE-FG02-86ER40281.

10:15AM 1WA.00004 COFFEE BREAK –

10:40AM 1WA.00005 Viscosity and heavy ion collisions
DENES MOLNAR, Purdue University & RIKEN BNL Research Center —
I will first review the essential ingredients of causal viscous hydrodynamics. The region of validity of the approach will be discussed based on comparison with nonequilibrium transport theory near the hydrodynamic regime. Then I will present calculations that show the influence of a small shear viscosity on heavy-ion observables at RHIC, mainly elliptic flow and spectra of light hadrons. These results will be used to estimate the shear viscosity of hot quark-gluon matter at RHIC. The effects of bulk viscosity will also be discussed.

11:15AM 1WA.00006 Full jet-reconstruction in Au+Au collisions at RHIC
JOERN PUTSCHKE, Yale University —
Measurements of inclusive hadron suppression and di-hadron azimuthal correlations in ultra-relativistic nuclear collisions have provided important insights into jet quenching in hot QCD matter, but are limited in their sensitivity due to well-known biases. Complete jet reconstruction in heavy-ion collisions would provide a direct measurement of the energy of the scattered parton before energy loss, alleviating such biases and allowing a measurement of the energy loss probability distribution necessary to extract properties of the medium in a model-independent way from hard probes. Recently at RHIC the first measurements of fully reconstructed jets in heavy-ion collisions were performed. Comparison of the jet energy spectra and the fragmentation function in Au+Au collisions to p+p reference measurements will be presented and discussed.

11:50AM 1WA.00007 What we may learn from a beam energy scan at RHIC
PAUL SORENSEN, Brookhaven National Lab —
Recent measurements at RHIC reveal correlations unique to Heavy-ion collisions that exhibit an abrupt transition with energy. In this talk I discuss scenarios that may account for these correlation structures. I discuss what can be learned from the beam energy dependence of these structures and argue that performing a beam energy scan at RHIC will provide an unprecedented opportunity for discovery.

Thursday, October 23, 2008 8:30AM - 12:25PM –
Session 1WB Workshop: From Quarks to the Cosmos with Petaflops: Large-Scale Computation in Nuclear Physics
Jewett Ballroom ABC

8:30AM 1WB.00001 Petascale Architectures for Nuclear Physics Computation
JAMES SEXTON, IBM T. J. Watson Research Center —
The next few years will be a time of considerable innovation in computer architectures as efforts expand to develop petascale and exascale systems for all computational disciplines. On the top 500 list, the first sustained petascale system has now been delivered at Los Alamos National Laboratory. The technology challenges to the delivery of sustained petascale computational capability are both significant and surprising. Power, memory capacity, data management, and reliability are emerging as critical system issues for the production use of petascale systems. High performance software libraries and middleware environments are now essential to enable application development and deployment for production computational use. This paper presents the current status of systems architectures for petascale computing, and discusses the approaches which are emerging to deliver effective, productive petascale solutions.
9:05AM 1WB.00002 Recent Developments in Lattice QCD. MARTIN SAVAGE, University of Washington — Lattice QCD is rapidly evolving toward the calculation of nonperturbative strong interaction observables at the physical quark masses with complete control over systematic uncertainties. I will outline the recent progress that has been made in the field, both at finite and zero temperature. Further, I will present progress in calculating the interactions between hadrons, and present estimates of the computational needs for nuclear physics.

9:40AM 1WB.00003 Ab initio nuclear structure - advances and challenges1. JAMES VARY, Iowa State University — I will present an overview of recent advances in ab-initio methods used in p-shell nuclei and beyond. The main focus will be on Greens Function Monte Carlo (GFMC), Coupled Cluster (CC) and the No-Core Shell Model (NCSM). I will introduce Chiral Effective Field Theory (EFT) Hamiltonians that provide a bridge between QCD and non-relativistic nucleon-nucleon and multi-nucleon interactions. Leadership-class supercomputers play a key role in achieving these results and I will show some measures of performance. Major physics accomplishments and new challenges will round out the overview.

1Supported in part by USDOE grants DE-FC02-07ER41457 and DE-FG-02-87ER40371.

10:15AM 1WB.00004 COFFEE BREAK –

10:40AM 1WB.00005 Computational perspectives in nuclear reactions, FILOMENA NUNES, Michigan State University — Nuclear reactions are crucial to probe the structure of nuclei, in particular for unstable systems. They can also provide important astrophysical information. However, it is only in the last decade, as a wider variety of mechanisms are consistently included in the reaction model and more structure information is taken into account, that modelling nuclear reactions has become computationally intensive. In this talk I will give a snapshot of the state of the art calculations including some results on breakup and transfer reactions with light exotic nuclei. I will show some results on performance and will discuss the degree of parallelism in the codes as well as the bottlenecks we need to resolve when scaling up to Petaflops machines. Finally, I will conclude with a vision of where we would like to be in a decade.

11:15AM 1WB.00006 Computational Supernovae: Nuclear Astrophysics’ Grand Challenge1. ADAM BURROWS, Princeton University — To address the theoretical supernova explosion problem with physical fidelity requires the development and use of sophisticated numerical radiation/hydrodynamic codes that simulate the multi-dimensional flow in a variety of Mach-number regimes. Though the latest simulations incorporate rotation, multi-group radiative transfer, and magnetic fields, they are not yet general-relativistic, do not solve the Boltzmann equation in its full multi-D context, and are not fully 3D in space. One must eventually do the calculations in six-dimensional phase space (plus time), and such seven-dimensional calculations are currently beyond reach. Nevertheless, there has been much recent progress and this progress has been informed by numerical experiments that will only get better in the next 3-5 years. In this talk, I will discuss the latest physical ideas in the theory of the mechanism of core-collapse supernovae and the variety of results that have emerged from recent massive computations. Moreover, I will motivate what more may need to be done to solve in credible fashion the enigma of stellar death and supernova explosion.

1Supported by the SciDAC program of the U.S. D.O.E.

11:50AM 1WB.00007 Opportunities for Nuclear Physics to benefit from Grid Computing, FRANK WUERTHWEIN, UCSD — Over the last few years, large globally distributed compute and storage infrastructures have emerged. These “grid infrastructures” are ideally suited for high throughputs computing, and are used in a variety of scientific domains, especially experimental particle physics. I will discuss the Open Science Grid infrastructure, and how it is used, by giving successful examples, some of which are taken from Nuclear Physics. This will provide an introduction to the technology, as well as the services available to adopt legacy applications to the grid.

Thursday, October 23, 2008 8:30AM - 12:25PM –

Session 1WC Workshop: Nuclear Physics Underground Simmons Ballroom

8:30AM 1WC.00001 Studying the Universe Underground. HITOSHI MURAYAMA, IPMU Tokyo and UC Berkeley — To study the Universe, underground would sound like the last place for the purpose. It turns out that it may well be the best place for it. I will discuss why it is so, using examples of various big questions about the Universe. What is it made of? Why do we exist? How do the stars shine?

9:05AM 1WC.00002 Recent results and prospects from neutrino oscillation experiments. MILIND DIWAN, Brookhaven National Laboratory — I will review the phenomenology and recent data mainly from terrestrial neutrino oscillation experiments. My focus will be experimental issues such as event rates, backgrounds, resolution, and sensitivity. I will conclude with a description of future activities in this field at reactors and deep underground detectors.

9:40AM 1WC.00003 Review of double beta decay experiments. ANDREA POCAR, Stanford University — Neutrinoless double beta decay is being investigated by experiments in underground laboratories around the world employing different candidate isotopes. I present a summary of the current status and sensitivities of such searches and describe the most promising next generation experiments under way which are designed to reach Majorana neutrino mass sensitivities of a few tens meV.

10:15AM 1WC.00004 COFFEE BREAK –

10:40AM 1WC.00005 Direct Detection of Dark Matter. HANGLEWU WANG, UCLA Physics and Astronomy — I will review the latest experimental advances in the search for Weakly Interacting Massive Particles (WIMPs) dark matter, focusing particularly on the direct detection approach. Following a very brief discussion on the motivations for this search, I will focus on the principle of WIMP direct detection, its advantages and limitations. The current techniques having achieved the most competitive results in terms of sensitivity will then be discussed. I will conclude with a brief overview of the future of direct detection experiments, the techniques considered and their sensitivity goals.
11:15AM 1WC.00006 Nuclear Astrophysics at the Gran Sasso Underground Laboratory, HEIDE COSTANTINI, INFN-Genova — The origin and build up of elements is one of the key questions for our understanding of the universe. Thermonuclear nucleosynthesis processes occurring in stellar and explosive scenarios are responsible for the production of the elements. The talk will focus on the experimental study of quiescent stellar H and He burning nuclear reactions which cross section measurements are hampered mainly by extremely low counting rate and cosmic background. Some of the main reactions of H-burning phase have been measured at the LUNA facility (Laboratory for Underground Nuclear Astrophysics) taking advantage of the very low background environment of the Underground Gran Sasso National Laboratory in Italy. An overview of the adopted experimental techniques will be given together with the results on the 14N(p,g)15O and 3He(4He,g)7Be reactions and the status of the ongoing experiments. Furthermore a brief summary of possible future studies and experimental methods that could be used in a new underground facility, will be presented.

11:50AM 1WC.00007 SNOLAB: Status and Scientific Program, TONY NOBLE, Queen’s University — SNOLAB is a new international facility for underground science, currently nearing completion in Sudbury, Canada. With the deepest clean laboratory in the world, SNOLAB is poised to begin operations with a rich scientific program. The status of SNOLAB and the experimental program will be presented.

Thursday, October 23, 2008 2:30PM - 5:30PM —
Session AA A Broad Perspective on Nuclear Physics: Where are we now and where do we go from here?  Jewett Ballroom

2:30PM AA.00001 Exploring Matter at the Femtoscale1, ROY HOLT, Argonne National Laboratory — Quantum chromodynamics (QCD) is accepted as the theory of the strong interaction, but it leaves many unanswered questions. World-wide efforts are aimed at understanding hadronic structure and at observing exotic QCD phenomena. Some highlights of recent progress and emerging mysteries as well as an outlook will be presented.

3:06PM AA.00002 Exploring Atomic Nuclei1, THOMAS GLASMACHER, Michigan State University — Atomic nuclei were discovered almost a century ago. Stable isotopes found on earth are now well-studied and sophisticated models and theories have been developed to reliably predict their properties. With accelerated heavy-ion beams in the 1960s and 1970s it became possible to extend our knowledge to unstable nuclei relatively close to stability. Starting in the late 1980s it became apparent that exotic nuclei far from stability could exhibit qualitatively different properties from well-bound nuclei. Now that it is established that descriptions which were appropriate for stable nuclei loose their predictive power for exotic nuclei, we are at the dawn of a new era of science with atomic nuclei: An era where we will be able to test our revised and progressing understanding of atomic nuclei against experiments performed with specifically chosen isotopes. Future discoveries and resulting insights are enabled by new, dedicated facilities around the world. This talk will review the worldwide opportunities in advancing our understanding of atomic nuclei in the next decade.

3:42PM AA.00003 COFFEE BREAK —

4:18PM AA.00004 The Golden Age for Studying Hot QCD Matter, JAMES NAGLE, University of Colorado — Twenty years ago, the study of hot QCD matter took off with the beginning of fixed target heavy ion experiments at the Brookhaven AGS and CERN SPS. Almost ten years ago, the center of mass energy of these collisions was increased by an order of magnitude with the completion of the Relativistic Heavy Ion Collider at Brookhaven. This jump in energy, the dedicated nature of the facility, and the investment in experiments has allowed for both a broad characterization and detailed probing of the hot QCD matter created. In the coming decade, critical detector and accelerator upgrades at RHIC, the coming online of the Large Hadron Collider at CERN, and other worldwide efforts will bring these studies into what can be termed a Golden Age. In this talk, we will review what has been learned, and suggest what may be revealed by future efforts.

4:54PM AA.00005 Neutrinos and Fundamental Symmetries: An Era of Discovery, ROBERT MCKEOWN, Caltech — The last decade has produced remarkable discoveries in neutrino physics including the only laboratory evidence to date for physics beyond the Standard Model. New neutrino experiments are planned to further explore the properties of neutrinos and to continue this era of neutrino discoveries. In addition, new experimental programs are poised to explore the Terascale, where massive new particles in the TeV range are expected to be discovered. These new experiments include measurements of fundamental symmetries that can help reveal the nature of new physics at the Terascale (and beyond) and provide complementary information to direct searches for new particles at the Large Hadron Collider. I will present an overview of the exciting prospects for new discoveries in these areas of experimental research.

Friday, October 24, 2008 8:30AM - 10:18AM —
Session BA Signatures for Chiral Symmetry Restoration in Nuclei  Simmons Ballroom 2-3

8:30AM BA.00001 Hadrons in Medium1, ULRICH MOSEL, Universitaet Giessen — That hadrons can change their properties, i.e. spectral functions and interactions, when they are embedded in the nuclear environment should come as no surprise since they interact with their surroundings. The interest in this phenomenon has been reawakened about 2 decades ago when possible connections of these in-medium changes with properties of QCD were pointed out. In particular, interest focussed on chiral symmetry restoration, expected to take place in the nuclear medium. In this talk I will assess the theoretical basis for these expectations and then discuss our present calculations of in-medium properties of vector mesons. I will then confront these expectations with experiments performed on cold matter where the interpretation of observables should be cleanest.

1Work supported by BMFT.
recoil polarization in Hall C at Jefferson Lab. The role of these distributions in understanding the structure of the nucleon will be discussed.

Maryland — The most general parton distributions that one can define are 6-dimensional Wigner quantum phase-space Wigner distributions. Different 

from stable nuclei has been investigated at ELSA with the Crystal Barrel/TAPS setup. The 

— Experiment E04-108 in Hall C at Jefferson Lab measured the ratio of the proton's electric (at least part of the effect can be explained by FSI.

from the heavy targets (A > 2) were compared with the mass spectra extracted from vector meson photoproduction. We obtain mass-shift compatible with zero for the \( \rho \) meson. For the \( \omega \) and \( \phi \) mesons, the empirical width is consistent with standard nuclear many-body effects, i.e. collisional broadening and Fermi motion. Even though the \( \omega \) and \( \phi \) mesons have a high probability of decaying outside the nucleus in their vacuum state, their in-medium widths can be accessed through their absorption inside the nucleus. The signature of absorption is a decrease of the nuclear transparency of these mesons as a function of target nucleons. Preliminary results indicate a substantial widening of the \( \omega \) and \( \phi \) mesons in the medium.

9:42AM BA.00003 Photoproduction of mesons off nuclei and in-medium modifications of hadrons, BERND KRUSCHE, University of Basel — During the last few years, the TAPS, Crystal Barrel, and Crystal Ball collaborations have investigated in-medium effects on hadrons at the MAMI accelerator in Mainz and the ELSA accelerator in Bonn in photon induced meson production reactions. There are many predictions that vector mesons change mass and width in dense and hot nuclear matter, due to partial chiral symmetry restoration. The predicted size of the effects is related to nuclear density and temperature, so that many efforts have been directed towards heavy ion collisions. However, the baryon density varies dramatically with time due to the formation and expansion of the ‘fireball’, which complicates the interpretation. Furthermore, FSI effects are large, so that only mesons decays into leptons (Dalitz-decays of \( \rho \) and \( \omega \) mesons) could be used. In an alternative approach, photo-production of \( \omega \) mesons from stable nuclei has been investigated at ELSA with the Crystal Barrel/TAPS setup. The \( \omega \) mesons were identified via their \( \pi^+\pi^-\gamma \) decay. The advantages of this experiment are the much larger decay branching ratio (8.5% for \( \omega \to \gamma\pi^0 \) compared to \( 7 \times 10^{-7} \) for \( \omega \to e^+e^- \)), the almost complete suppression of background from the \( \rho \) meson \( (\rho \to \pi^+\pi^-\gamma \) decay branching ratio: \( 8 \times 10^{-1} \)) and the better control over experimental parameters like nuclear density. The experiment has for the first time directly established a downward shift of the \( \omega \)-mass in nuclear matter via a comparison of the line shape of the \( \omega \) invariant mass peak observed in photo-production off the free nucleon to the nuclear data. A detailed analysis of the scaling of the observed cross sections with nuclear mass number in the framework of different models has found an inelastic in-medium width of the \( \omega \) meson in the range 130 - 150 MeV/c^2 at normal nuclear matter density for an average three-momentum of 1.1 GeV/c. Furthermore, a momentum dependent \( \omega N \) cross section in the range of 70 mb has been extracted. In the sector of scalar mesons, in a series of experiments, double pion photo-production off heavy nuclei has been studied in view of possible in-medium effects on the much discussed \( \sigma \)-meson. Results from a measurement of double \( \pi^0\pi^0\) and \( \pi^+\pi^-\gamma \) photo-production off carbon and lead have shown for the heavier nucleus a shift of the strength to lower invariant masses for the \( \pi^+\pi^-\gamma \) channel; but not for the mixed charge channel. This is a possible argument, that the effect does not arise from FSI, which is assumed to be similar for neutral and charged pions. However, more detailed comparisons to model calculations have shown, that at least part of the effect can be explained by FSI.

Friday, October 24, 2008 8:30AM - 10:18AM – Session BB Mini-Symposium 3: 3D View of the Nucleon and Its Spin 1 – Room 208

8:30AM BB.00001 Nucleon Structure and Master Parton Distribution, XIANGDONG JI, University of Maryland — The most general parton distributions that one can define are 6-dimensional Wigner quantum phase-space Wigner distributions. Different projections will lead to different reduced distributions which can be probed in experiment such as generalized parton distributions and transverse-momentum dependence parton distributions. The role of these distributions in understanding the structure of the nucleon will be discussed.

9:06AM BA.00002 Proton electromagnetic form factor ratio at high momentum transfer via recoil polarization in Hall C at Jefferson Lab — ANDREW PUCKETT, MIT, JEFFERSON LAB HALL C GEP-III COLLABORATION — Experiment E04-108 in Hall C at Jefferson Lab measured the ratio of the proton’s electric (\( G_E \)) and magnetic (\( G_M \)) form factors using the recoil polarization technique at three different values of squared four-momentum transfer \( Q^2 = 5.2, 6.8, \) and 8.5 GeV^2. Data taking was completed in June 2008, and analysis of the data is underway. Two new detectors were built by the collaboration to carry out this experiment. A large solid-angle electromagnetic calorimeter was used to detect elastically scattered electrons in coincidence with scattered protons detected by the Hall C High Momentum Spectrometer (HMS). The calorimeter allowed a clean rejection of the significant inelastic backgrounds present at such high \( Q^2 \). A new Focal Plane Calorimeter (FFP) was installed in the HMS detector hut to measure the polarization of the scattered proton. After a brief overview of the experiment, the present status of the analysis will be discussed.

3Supported in part by DOE/NSF

9:18AM BA.00003 Deeply Virtual Compton Scattering with CLAS, FRANCOIS-XAVIER GIROD, Jefferson Laboratory, CLAS COLLABORATION — As the lightest of all baryons, and the single stable hadron, the proton can be considered as the simplest laboratory tool to investigate the non-perturbative structure of QCD. The interest in the nucleon structure has been renewed over the past decade, due to the development of the Generalized Parton Distribution (GPD) formalism. The cleanest process to test the GPDs is Deeply Virtual Compton Scattering, which is the electroproduction of photons in the Bjorken regime of large \( Q^2 \) and \( x \), at fixed \( x_f \) and small \( t \). In order to access this process, the CEBAF Large Acceptance Spectrometer (CLAS) has been upgraded by the addition of a new calorimeter to detect photons at small angles. I will present an overview of the E1-DVCS experiment, starting from the conception and construction of the equipment to simulations and data taking. I will show results for the Beam Spin Asymmetry, which is linked to GPDs. I will conclude by giving perspectives on GPDs measurements at 6 and 12 GeV with CLAS.

9:30AM BA.00004 Measurement of the Double Longitudinal Spin Asymmetry for Charged Pion Production in 200 GeV Polarized \( p+p \) Collisions at RHIC, BERND SURROW, MIT, STAR COLLABORATION — A primary goal of the STAR spin physics program at RHIC is the measurement of the gluon polarization, \( \Delta g \), in the proton. The STAR detector, with its large-acceptance tracking and calorimetry, provides a uniquely suited environment for asymmetry measurements in a number of different final-state channels in polarized \( p+p \) collisions such as inclusive jet production [1], charged and neutral pion [2] production. These asymmetries will provide important contributions to a global analysis of delta g. We present here the most recent measurements of the double longitudinal spin asymmetry (ALL) for the production of charged pions at mid-rapidity. These asymmetries are compared to NLO pQCD calculations for different gluon polarization scenarios and are used to provide constraints on delta g. Charged pions are of particular interest as they are sensitive to the sign of delta g. Results and continuing analyses are presented from RHIC runs 5 and 6. [1] Will Jacobs, Recent Longitudinal Spin Asymmetry Measurements for Inclusive Jet Production at STAR, DNP 2008 Fall meeting. [2] Olekczuk, Grebenyuk, Longitudinal Double-Spin Asymmetry and Cross Section for Inclusive Neutral Pion Production in Polarized \( p+p \) Collisions at RHIC, DNP 2008 Fall meeting.
9:42 AM BC.00005 Beam Spin Asymmetry Measurements from Deeply Virtual Eta Production, ZHAO BO, MAURIZIO UNGARO, KYUNGSEON JOO, CLAS COLLABORATION — We present for the first time measurements of the Beam Spin Asymmetry (BSA) from Deeply Virtual Eta Production. With the 1-DVS experiment at JLAB we have access to Deep Virtual pseudo-scalar Meson Production and consequently to the properties of the polarized Generalized Parton Distributions (GPDs) and/or Regge phenomenology. The experiment was run with the CLAS detector during the spring of 2005, using a 5.7 GeV longitudinally polarized electron beam impinging on a liquid Hydrogen target. Preliminary results show a large (15%) and constant (in Q2, t, x) BSA indicating a non zero longitudinal-transverse interference in contrast with the GPD assumptions.

9:54 AM BC.00006 Spin Structures of the Deuteron and the Neutron - New Results from CLAS, NEVZAT GULER, Old Dominion University, CLAS COLLABORATION — In the EGI experiment, carried out at Jefferson Lab using the CLAS detector, we have measured double polarization asymmetries in and above the nucleon resonance region (1.08 GeV < W < 3.0 GeV). We used a longitudinally polarized electron beam with energies of 1.6, 2.5, 4.2 and 5.75 GeV incident on longitudinally polarized proton and deuteron targets. The large kinematic coverage of the experiment (0.05 GeV2 < Q2 < 5.0 GeV2) helps us to understand the spin structure of the nucleon, especially in the transition region between hadronic and quark-gluon degrees of freedom. We will present results on A1, g1 and T1; using the entire data set for the deuteron and extractions of the neutron spin structure functions from the combined deuteron and proton data.

10:06 AM BC.00007 Spin Asymmetry on the Nucleon Experiment, HOVHANNES BAGHDASARYAN, University of Virginia, SANE COLLABORATION — The Spin Asymmetry on the Nucleon Experiment (SANE) is a measurement of the spin structure function A1p over a broad range of Bjorken scaling variable x from 0.3 to 0.8, for four-momentum transfers from 2.5 GeV2 to 6.5 GeV2. The experiment will measure inclusive double spin asymmetries using TJNAF polarized electron beams of about 4.8 and 6 GeV energies, scattered off UVA solid polarized NH3 target. The experiment will take place in 2008. We will discuss the physics motivation for SANE as well as the proposed experimental arrangement, and expected results.

Friday, October 24, 2008 8:30AM - 10:18AM – Session BC Mini-Symposium: Neutrino Properties and Nuclear Physics I

8:30 AM BC.00001 Neutrinos: Particles with Maddeningly Few Properties1, R.G. HAMISH ROBERTSON, Center for Experimental Nuclear Physics and Astrophysics, University of Washington, Seattle, WA 98195 — It might be thought that a particle with no charge, half-integer spin, and very little mass could not really be that complicated. Yet it took nearly 70 years to discover that they had any mass at all, and in the process the objects with well-defined mass were found not to have well-defined flavor and vice versa. Exactly what the mass is still remains unknown. The mixing of the quarks, particles that cannot even be observed in isolation, is small but precisely known. For neutrinos, an angle, θ13, is still missing. Ordinarily it would be trivial to decide whether a particle and an antiparticle were the same or not, and yet a trick of the weak interaction has cloaked this basic property for neutrinos, demanding experiments of heroic scale and difficulty to unmask. What will it take to get the answers?

1Research Supported by DOE under grant DE-FG02-97ER41020

9:06 AM BC.00002 Into the Depths: Lowering the Energy Threshold at the Sudbury Neutrino Observatory, GABRIEL OREBI GANN, University of Pennsylvania, SUDbury Neutrino Observatory Collaboration — The Sudbury Neutrino Observatory has successfully demonstrated the phenomenon of neutrino oscillation by observing both the total active solar neutrino flux, via the Neutral Current interaction on deuterium, and the pure νe component via the Charged Current interaction. An improved analysis of SNO data aims to lower the energy threshold of the analysis, resulting in increased statistics and a greater sensitivity to possible distortions in the incident neutrino energy spectrum. This talk discusses some of the improvements made in order to achieve a high precision measurement.

9:18 AM BC.00003 Measuring the energy dependence of the νe survival probability at the Sudbury Neutrino Observatory, STANLEY SEIBERT, University of Texas, SUDbury Neutrino Observatory Collaboration — The Sudbury Neutrino Observatory has excellent sensitivity to the solar neutrino energy spectrum through the charged-current interaction with deuterium. Assuming a known 13C neutrino spectrum at the production point in the Sun, we can obtain the μν survival probability on Earth as a function of neutrino energy. This talk describes a new method for obtaining these survival probability functions directly from the SNO data set using a maximum likelihood fit. The kernel estimation technique is used to build unbinned, non-parametric, multidimensional probability density functions from Monte Carlo event samples which can be reweighted on-the-fly as the fit parameters describing the survival probability function are varied. This method also allows the survival probability function to be obtained simultaneously for upward and downward-going (night and day) neutrinos for tests of νe regeneration in the Earth.

9:30 AM BC.00004 Neutrino physics with cold atoms, MELISSA JERKINS, University of Texas at Austin — Recent advances in atomic slowing and cooling are opening new avenues through which to explore neutrino properties. I will discuss several potential applications of these technologies to neutrino research, including new concepts for tritium β-decay and neutrino Mossbauer experiments. The absolute mass scale of the neutrino has long been probed through tritium β-decay, but these technically challenging experiments have so far been unable to detect the neutrino mass. By utilizing a slow, cold beam of tritium atoms to create the tritium source, one could detect both the helium ion and the β, which implies that the neutrino mass could be directly reconstructed. I will present simulation results and discuss the feasibility of both a three-body tritium β-decay experiment and a boundstate tritium β-decay experiment. I will also discuss preliminary explorations of a neutrino Mossbauer experiment in which advances in magnetic slowing of atoms allow trace detection of tritium created in recoilless reverse tritium beta decay. Observation of the Mossbauer effect with neutrinos would be an exciting first step toward tabletop neutrino oscillation experiments.

9:42 AM BC.00005 Setting Limits on the Local Density of the Cosmic Neutrino Background Using KATRIN, ASHER KABOTH, Massachusetts Institute of Technology, KATRIN COLLABORATION — The relic neutrinos of the cosmic neutrino background are nearly as numerous as the photons in the cosmic microwave background. However, due to their low energy—predicted to be 1.9K in the Standard Model—they are very difficult to detect directly. One process, neutrino capture on tritium (νe + T → He3 + e−), presents a threshold-free way to detect such low energy neutrinos. Such a process would show up as a spike in the tritium beta decay spectrum above the beta decay endpoint. The KATRIN experiment, which uses tritium beta decay to measure the electron neutrino mass, has potential sensitivity to this neutrino capture process if the local density or the cross section is significantly greater than expected. This talk describes KATRIN's sensitivity to this process and its implications for the cosmic neutrino background.
9:54AM BC.00006 Coherent Neutrino Detection at SONGS, JUAN COLLAR, University of Chicago, C. AALSETH, P. BARBEAU, A. BERNSTEIN, N. BOWDEN, J. COLARESI, S. DAZELEY, P. DE LURGIO, G. DRAKE, J.E. FAST, C.H. GREENBERG, T.W. HOSSBACH, J.D. KEPHART, J. LUND, M.G. MARINO, H.S. MILEY, J.L. ORRELL, D. REYNA, R.G.H. ROBERTSON, L. SADLER, R. TALAGA, O. TENCH, T.D. VAN WECHEL, J.F. WLKERSON, M. YOCUM, COGENT COLLABORATION — An effort to demonstrate (anti)neutrino coherent elastic scattering off nuclei is underway in one of the tandem galleries around the San Onofre Nuclear Generating Station (SONGS) reactors. We are currently employing p-type point contact (PPC) germanium detectors as the target. These devices combine a sub-keV energy threshold with a mass (∼1 kg) large-enough to observe the effect, profiting from the very large cross section expected. An overview of activities and prospects will be presented. 

10:06AM BC.00007 CLEAR:Prospects for a Low Threshold Neutrino Experiment at the SNS, JAMES NIKKEL, Yale University, CLEAR COLLABORATION — CLEAR (Coherent Low Energy A(Nuclear) Recolls) is a proposed detector that will utilize noble liquid targets to measure coherent neutral current neutrino-nucleus elastic scattering. During this talk, I will discuss the CLEAR proposal and the physics reach of this detector installed at the Spallation Neutron Source.

Friday, October 24, 2008 8:30AM - 10:18AM – 
Session BD Mini-Symposium: Rare Isotope Science I, Jewett Ballroom G-H

8:30AM BD.00001 Rare Isotope Science, PAUL GARRETT, University of Guelph — The development of radioactive-beam facilities worldwide, such as those at ISOLDE, TRIUMF-ISAC, the NSCL, HBIBF, RIKEN, GALAN, GSI, etc., has provided a tremendous potential for nuclear physics in general and specifically nuclear physics. The ability to produce record-intensity radioactive-ion beams both near and far from stability has enabled new avenues of research in nuclear structure, nuclear astrophysics, weak-interaction studies, material science, and applied physics. Combined with the development of production facilities, significant advancements in instrumentation have occurred that have maximized sensitivity to the physics events of interest in the presence of, at times, very large radioactive backgrounds. An overview of the two main production techniques, ISOL and fast-fragmentation, will be given, together with some selected developments in spectrometers and detection systems. Some physics highlights that have resulted from these advancements will be outlined. Finally, recent results and future prospectives for nuclear physics studies at the TRIUMF-ISAC facility, currently the world’s most powerful ISOL facility, will be presented, including plans for a 500 kW electron linac driver for photofission.

1Work support in part by the Natural Sciences and Engineering Research Council, Canada

9:06AM BD.00002 Further results in the search for the direct two-proton decay of $^{94}$Ag$^{m+}$ ($J^{π}$ = 21$^+$, 6.7 MeV), J. CERNY, UC Berkeley/LBNL, D.W. LEE, LBNL, K. PERAJARVI, STUK, D.M. MOLTZ, B.R. BARQUEST, L.E. GROSSMAN, W. JEONG, C.C. JEWETT, UC Berkeley — Both direct one-proton decay and direct two-proton decay of $^{94}$Ag$^{m+}$ from this 0.4 s isomeric state have been reported in experiments utilizing the GSI on-line mass separator [1]. In the latter decay, coincident events between silicon E detectors with a threshold energy of 0.4 MeV and a summed decay energy of 1.9±0.1 MeV were observed with a yield of 350±210 pb in coincidence with $\gamma$-decays in the $^{22}$Rh daughter. We utilized our helium-jet system at the LBNL 88-inch cyclotron to repeat this experiment, again employing the $^{54}$Ni($^{40}$Ca,p3n) reaction at 197 MeV. Reaction products were transported via a capillary to a detection area and collected on a slowly rotating wheel in front of an assembly of 24 $\Delta E_{\text{Si}}, \Delta E_{\text{Si}}, E_{\text{Si}}$ detector telescopes with a threshold of 0.4 MeV for identifying protons. Five of these telescopes observe the 0.79 MeV single proton decay from $^{94}$Ag$^{m+}$ at the reported yield of 1.3 nb. In the 240/276 identified proton detector combinations with low background, no proton-proton coincidences have been observed. Data from the remaining 36 detector combinations require a separate analysis, which is in progress. Monte Carlo analyses of our anticipated proton-proton coincidences for both sets of detector combinations will be presented. [1] Mukha et al., Nature 439, 298 (2006).


1The NSCL is funded in part by the NSF and MSU. This work is supported in part by US NSF Grant No. PHY-0606007.

9:30AM BD.00004 Ultra-High Precision Half-Life Measurement for the Superallowed $^{26}$Al$^{m}$, P. FINLAY, G. DEMAND, P.E. GARRETT, K.G. LEACH, A.A. PHILLIPS, C.S. SUMITHRACHCHI, C.E. SVENSSON, S. TRIAMBAK, University of Guelph, G.C. BALL, D. BANDYPADHYAY, M. DJONGOLOV, S. ETTENEAUER, G. HACKMAN, C.J. PEARSON, S.J. WILLIAMS, TRIUMF, C. ANDREOIU, D. CROSS, Simon Fraser University, R.A.E. AUSTIN, St Mary’s University, G.F. GRINYER, NSCL/MSU, J.R. LESLIE, Queens University — The calculated nuclear structure dependent correction for $^{26}$Al$^{m}$ ($\delta c - \delta NS = 0.305(27)\%$) [1] is smaller by nearly a factor of two than the other twelve precision superallowed cases, making it an ideal case to pursue a reduction in the experimental errors contributing to the $\beta$ value. An ultra-high precision half-life measurement for the superallowed $^{26}$Al$^{m}$ has been made using a 4π continuous gas flow proportional counter as part of an ongoing experimental program in superallowed Fermi $\beta$ decay studies at the Isotope Separator and Accelerator (ISAC) facility at TRIUMF in Vancouver, Canada, which delivered a beam of $\sim 10^{15}$ $^{26}$Al$^{m}$/s in October 2007. With a statistical precision of $\sim 0.008\%$, the present work represents the single most precise measurement of any superallowed half-life to date. [1] I.S. Towner and J.C. Hardy, Phys. Rev. C 77, 025501 (2008).
9:42AM BD.00005 Quadrupole Moment of $^{37}$K$^+$. K. MINAMISONO, P.F. MANTICA, H.L. CRAWFORD, J.S. PINTER, J.B. STOKER, R.R. WEERASIRI, NSCL/MSU, Y. UTSUNO, Japan Atomic Energy Agency/NSCL/MSU — The electric quadrupole coupling constant of the ground state of $^{37}$K($I^*=3/2^+$, $J_{1/2}=1.22$ s) in a tetragonal KH$_2$PO$_4$ single crystal was measured to be $|eQ/h|=2.90 \pm 0.07$ MHz. The experiment was performed at NSCL using a newly-developed $\beta$-ray detecting nuclear quadrupole resonance system. The electric quadrupole moment of $^{37}$K was determined to be $|Q(^{37}$K)| = 10.6 \pm 0.4$ fm$^2$, where the known electric quadrupole coupling constant of stable $^{36}$K in the KH$_2$PO$_4$ crystal [1] was used as a reference. The present experimental result is consistent with but more precise than the previous value $(11 \pm 4$ fm$^2$) measured by laser spectroscopy [2]. The present result is larger than that predicted by shell-model calculations in the $sd$ or the $sf$ model spaces. Evaluation of effective charges in this region of the chart of nuclides will be presented as one means to reconcile the discrepancy between experiment and theory. [1] J. Seliger, V. Zagar, Phys. Rev. B 49, 14918 (1994). [2] J. A. Behr et al., Phys. Rev. Lett. 79, 375 (1997).

3This work was supported in part by the National Science Foundation, Grant PHY06-06007.

9:54AM BD.00006 $\beta$-decay studies of nuclides in the $^{100}$Sn region at NSCL$^1$, GIUSEPPE LORUSO, ALAN AMTHOR, MSU, THOMAS BAUMANN, DANIEL BAZIN, NSCL, ANA BECERRIL, MSU, HEATHER CRAWFORD, NSCL, ALFREDO ESTRADE, MSU, ALEXANDRA GADE, THOMAS GINTER, CAROL GUESS, MARK HAUSMANN, NSCL, WES HITT, MSU, PAUL MANTICA, NSCL, MILAN MATOS, RIANON MEHARCHAND, MSU, KEI MINAMISONO, FERNANDO MONTES, GIORGIOS PERDIKAKIS, JORQUE PEREIRA, JILL PINTER, MAURITIO PORTILLO, HENDRIK SCHATZ, NSCL — $\beta$-decay nuclides in the immediate neighborhood of $^{100}$Sn, were studid at NSCL using the $\beta$-Counting system (BCS) and the Segemented Germanium Array (SeGA). The nuclei of interest were implanted into the BCS double-sided silicon strip detector and properties from both implantations and the subsequent $\beta$-decays were recorded on an event-by-event basis, allowing for the direct observation of the half-lives and the $\beta$-delayed proton emission branching ratios. The BCS also contains a stack of Si detectors and a Ge planar detector downstream of the implantation detector to measure the total energy of the emitted beta particles, and hence the $\beta$-delay end-point energy. The properties of those nuclei are not only relevant for rp-process calculations but also are essential to understand the structure of the single particle states far from the line of stability, providing stringent tests of nuclear models in this region.

3This work is supported by NSF grants PHY02-16783 and PHY-06-06007.

10:06AM BD.00007 Low-energy transitions in $^{112}$Cd identified in the beta-decays of $^{112}$Ag and $^{112}$In, K.L. GREEN, P.E. GARRETT, G.A. DEMAND, G.F. GRIYER, K.G. LEACH, A.A. PHILLIPS, M.A. SCHUMAKER, C.E. SVENSSON, J. WONG, University of Guelph, G.C. BALL, D.S. BANDYOPADHYAY, G. HACKMAN, A.C. MORTON, C.J. PEARSON, TRIUMF, R.A.E. AUSTIN, S. COLOSIMO, St Marys University, D. CROSS, Simon Fraser University, J.I. WOOD, W.D. KULP, Georgia Tech, S.W. YATES, University of Kentucky — The Cd isotopes, especially $^{112}$Cd, have been considered exceptional examples of vibrational nuclei. While many level lifetimes are known in $^{112}$Cd, previous measurements lacked sensitivity to weak, low-energy branches that are often the most important transitions to establish collectivity. We have sought these branches through a high-statistics measurement of the $\beta$ decay of $^{112}$Ag and $^{112}$In to $^{112}$Cd using the 8r spectrometer at the TRIUMF-ISAC facility. The data were collected in scaled-down $\gamma$ singles and $\gamma\gamma$ coincidence mode, and $\sim 100 \times 10^6$ events were sorted into a random-background-subtracted $\gamma\gamma$ matrix. New branches from levels below 2.5 MeV were observed, and a higher precision on several branching ratios, especially the $4^-$ and $0^+$ doublet of states at 1871 keV, has been achieved. Details of the analysis will be reported. Work supported in part by NSERC and the US DOE under grant DE-FG02-96ER40958.

Friday, October 24, 2008 8:30AM - 10:06AM — Session BE Nuclear Theory: Computational — Simmons Ballroom 1

8:30AM BE.00001 Ab initio many-body calculations of nucleon scattering on $^{16}$O. PETR NAVRATIL, SOFIA QUAGLIONI, LLNL, ROBERT ROTH, TU Darmstadt — We develop a new $ab\ initio$ many-body approach$^1$ capable of describing simultaneously both bound and scattering states in light nuclei, by combining the resonating-group method$^2$ with the $ab\ initio$ no-core shell model (NCSM).$^3$ In this way, we implement a microscopic-cluster technique with the use of realistic interactions, and a microscopic and consistent description of the nucleon clusters, while preserving Pauli principle and translational symmetry. We will present results for low-energy nucleon scattering on $^{16}$O and for $A=17$ bound states obtained using realistic nucleon-nucleon potentials. The $^{16}$O wave functions are calculated within the importance-truncated NCSM,$^4$ that allows the use of model spaces $\nu \approx 18$ fm$^{-1}$ and ultimately enables to reach convergence of phase-shifts and other observables. Prepared by LLNL under Contract DE-AC52-07NA27344. Support from the U.S. DOE/SC/DP (Work Proposal No. SCV0498), and from the U.S. Department of Energy Grant DE-FG02-07ER41457 is acknowledged.


8:42AM BE.00002 Time-dependent Green’s Functions Approach to Nuclear Reactions$^1$, ARNAU RIOS HUGUET, NSCL and Physics & Astronomy Department, Michigan State University, East Lansing (MI), PAWEL DANIELEWICZ, BRENT BARKER, NSCL and Physics & Astronomy Dept., Michigan State University, East Lansing (MI) — Nonequilibrium Green’s functions represent underutilized means of studying the time evolution of quantum many-body systems. The Kadonoff-Baym equations describe the time evolution of quantum systems including memory effects and correlations beyond the mean field [1]. In nuclear physics, these have been solved for homogeneous matter [2,3], but few is known about the effects that correlations induce in a dynamical description of finite nuclei. This is particularly relevant for the case of central low-energy reactions (fusion, fission), where dissipative effects come into play [4]. We discuss the mean-field evolution for the density matrix of colliding slabs in 1D [5] and describe the extension of the dynamics to the correalted case in the Born approximation.


3This work is supported by the NSF, under Grant No. PHY-0555893.

8:54AM BE.00003 ABSTRACT WITHDRAWN —
9:06AM BE.00004 S-wave Pairing In Neutron Matter, ALEXANDROS GEZERLIS, Los Alamos National Laboratory / University of Illinois, JOSEPH CARLSON, Los Alamos National Laboratory — Low-density neutron matter is a strongly paired system, with a pairing gap of the order of the Fermi energy. Several many-body schemes have been devised in an attempt to calculate this pairing gap, since an accurate calculation of neutron matter properties may be important to the physics of neutron stars and of neutron-rich nuclei. We have calculated the T=0 equation of state and pairing gap for low-density neutron matter (as a function of the Fermi momentum times the scattering length) using a Quantum Monte Carlo method. These results are compared with previous calculations, including a recent work that makes use of the Auxiliary Field Diffusion Monte Carlo method, and also with infinitesimal-range calculations relevant to cold-atom physics.

9:18AM BE.00005 Generalized Auxiliary Field Monte Carlo method: a new efficient variational method for CBF theory1, MOHAMED BOUADANI, Arizona State University — A principle goal in nuclear theory is the development of computational methods to calculate hadronic systems properties. Correlated basis function theory, CBF, is believed to offer an accurate wave-function. Two approaches that have made important contributions are the diagrammatic viewpoint that try to compute in a self consistent way to all orders the dominant leading order diagrams such as the Fermi hypernetted Chain/ Single Operator Chain and Coupled Cluster theory, and, on the other hand, there are methods like Green function Monte Carlo, that aim to compute expectations of observables by stochastically evaluating the integrals via Monte Carlo method. Each of these approaches suffer important limitations that make further advances very difficult. To circumvent the principle obstacle, being that these correlations are state dependent and thus making any evaluation of such complex wave-function impractical for large systems, a new method designated as the Generalized Auxiliary Fields Variational Monte Carlo, GAFCVMC method has been successively implemented for the stochastic sampling of the CBF-type wave-functions with $\hbar p$ type operators. Some encouraging results will be given.

1Supported by NSF.

9:30AM BE.00006 A Random Matrix Study of the QCD Sign Problem1, JI LONG HAN, MIKHAIL STEPHANOV, Department of Physics, University of Illinois, Chicago, USA — We investigate the severity of the sign problem in a random matrix model for QCD at finite temperature T and baryon chemical potential $\mu$. We obtain analytic expression for the average phase factor — the measure of the severity of the sign problem at arbitrary T and $\mu$. We observe that the sign problem becomes less severe as the temperature is increased. We also find the domain where the sign problem is maximal — the average phase factor is zero, which is related to the pion condensation phase in the QCD with finite isospin chemical potential. We find that, in the matrix model we studied, the critical point is located inside the domain of the maximal sign problem, making the point inaccessible to conventional reweighting techniques. We observe and describe the scaling behavior of the size and shape of the pion condensation near the chiral limit.

1This research is supported by the DOE grant No. DE-FG0201ER41195.

9:42AM BE.00007 Current status of our microscopic predictions of the equation of state1, FRANCESCASAMMARRUCA, University of Idaho — Intense experimental efforts to constrain the nuclear equation of state (EoS) are in progress or in the planning stage. Isospin asymmetry is of particular interest. Therefore, corresponding theoretical calculations are important and timely. We will present and discuss most recent progress in our systematic exploring of diverse aspects of the equation of state, which includes predictions of hyperon energies in nuclear matter. Consideration of strangeness in the EoS is important in the low to normal density regime, where it complements studies of hypernuclei, as well as at the high densities typical for the core of neutron stars.

1Support from the U.S. Department of Energy under Grant No. DE-FG02-03ER41270 is acknowledged.

9:54AM BE.00008 Correlated momentum distribution in asymmetric nuclear matter1, ARNAU RIOS HUGUET, NSCL and Physics & Astronomy Department, Michigan State University, East Lansing (MI) — The understanding of the variation of microscopic nuclear properties with isospin asymmetry is an important issue for both nuclear experiments and theory. The recent results on nucleon knock-out reactions seem to indicate that there is a strong dependence of spectroscopic factor on isospin [1]. This could indicate that the occupation numbers of low-lying nuclear states are changing with asymmetry [2]. We perform realistic many-body calculations of asymmetric nuclear matter within the Self-Consistent Green’s Functions method to study the impact of isospin asymmetry on the correlated momentum distributions of asymmetric nuclear matter [2,3]. Using different internucleon potentials, we assess the model dependence of these calculations and conclude that the change of $n(k)$ with isospin is well constrained from realistic calculations.


1This work is supported by the NSF, under Grant No. PHY-0555893.

Friday, October 24, 2008 8:30AM - 10:18AM – Session BF Nuclear Reactions: Heavy-Ions Simmons Ballroom 4

8:42 AM BF.00002 Fragment emission and production in Peripheral Collisions in the Intermediate Energy regime, SARAH SOISSON, B. STEIN, G. SOULIOTIS, D. SHETTY, Texas A&M University, A. KEKSIOS, S. WUENSCHEL, S. J. YENNELLO, Texas A&M University — In recent years, examination of the kinetic energy spectra of emitted isotopes in multi-fragmentation reactions has shown that neutron-poor isotopes have larger mean kinetic energies than neutron-rich isotopes. Using the FAUST array, isotopically resolved fragments are detected from the reactions of A (∼ 20-40) projectiles with a heavy target, a reconstructed quasi-projectile can be determined. This reconstructed quasi-projectile allows for good source definition as well as good N/Z determination of the emitting source. By selecting on isotopically identified fragments emitted from well defined sources, it will be shown that the fragment contributions present in the Coulomb peak and the tail of the kinetic energy spectra evolve with the N/Z of the emitting source. Also, the fragment yield as a function of energy will be shown to be dependant on N/Z of the emitting source.

8:54 AM BF.00003 N/Z Equilibration in Peripheral Reactions on the FAUST Array, BRIAN STEIN, S.N. SOISSON, G.A. SOULIOTIS, D.V. SHETTY, S. GALANOPoulos, Cyclotron Institute, Texas A&M University, A.L. KEKSIOS, Los Alamos National Laboratory, S. WUENSCHEL, Z. KOHLEY, L. MAY, S.J. YENNELLO, Cyclotron Institute, Texas A&M University — In recent years, nucleon transport in peripheral heavy ion collisions has been proposed as a probe of the density dependence of the nuclear symmetry energy. Recently a high statistics data set was taken of the systems $^{32,36}S + ^{112,124}Sn$ at 45 MeV/A using the FAUST array. Quasi-projectiles have been reconstructed from isotopically resolved fragments (with mass identification up to Z = 14) to be used as a probe of the N/Z equilibration. Initial results show that quasi-projectiles are produced with a wide range of N/Z for each reaction system. Also, the quasi-projectile distributions show sensitivity to the N/Z of both the projectile and target used. Experimental results will be presented with comparisons to theoretical models.

9:06 AM BF.00004 Density-constrained TDHF calculation of fusion cross sections for neutron-rich nuclei, VOLKER OBERACKER, SAIT UMAR, Vanderbilt University — The density-constrained TDHF method [Ref. 1] is a fully microscopic theory for calculating heavy-ion interaction potentials and fusion cross sections below and above the fusion barrier. The only input into the theory is the effective NN interaction (Skyrme force). There are no adjustable parameters. The method is based on the TDHF evolution of the nuclear system slightly above the fusion barrier, coupled with density-constrained Hartree-Fock calculations. This approach incorporates all of the dynamical entrance channel effects such as neck formation, particle transfer, internal excitations and dynamical deformation effects. We will discuss applications to neutron-rich systems (64Ni + 132Sn, 64Ni + 64Ni, 40Ca + 96Zr). Several prescriptions for calculating the coordinate-dependent mass parameters (effective mass, dynamical reduced mass) within the DC-TDHF method will be presented, and we examine their influence on the total fusion cross section. Ref. 1: A.S. Umar and V.E. Oberacker, PRC 77, 064605 (2008)

9:18 AM BF.00005 Isotopic width distributions and symmetry energy, SARA WUENSCHEL, STRATOS GALANOPoulos, KRIS HAGEL, ZACH KOHLEY, DINESH SHETTY, SARAH SOISSON, GEORGE SOULIOTIS, BRIAN STEIN, SHERRY YENNELLO, Texas A&M University Cyclotron Institute — Within the Microcanonical Multifragmentation Model (MMM), the bulk versus surface contribution to the symmetry energy is predicted to be distinguishable. If the symmetry energy is dominated by the surface, the symmetry energy coefficient should evolve with the size of the fragment studied. However, if the bulk term dominates, the symmetry energy coefficient should be constant across all fragment sizes. Symmetry energy can be accessed through knowledge of the parameter $\alpha$. This parameter may be obtained by isoscaling [1] or isotopic widths [2]. Differentiation between bulk and surface requires isotopic widths across a wide array of elements. Projectile fragmentation of $^{64}$Kr + $^{14}$Ni at 35MeV/u was taken on the NIMROD-ISIS detector. The wide range of isotopic resolution seen in NIMROD-ISIS data allows the isotopic widths for Z = 3-15 to be extracted for this study. Events are characterized through reconstruction of the quasi-projectile. Isotopic width data will be presented.

9:30 AM BF.00006 Coupled Channel Calculations for Nucleon Induced Reactions, IAN THOMPSON, JUTTA ESCHER, FRANK DIETRICH, Lawrence Livermore National Laboratory, MARC DUPUIS, Los Alamos National Laboratory — An ab-initio calculation of the optical potential for nucleon-nucleus scattering has been performed by explicitly coupling the elastic channel to all the particle-hole (p-h) excitation states in the target. These p-h states may be regarded as doorway states through which the flux flows to more complicated configurations, and in the end to long-lived compound nucleus resonances. The random-phase approximation (RPA) provides the linear combinations of p-h states that include the residual interactions within the target, and we show preliminary results for elastic flux loss and total cross-section using both p-h and RPA descriptions of $^{90}$Zr and $^{208}$Pb target excitations for a wide projectile energy range. Within this procedure we were able to observe coupling and structure effects of the studied nuclei by comparing the different coupled channel calculations results with experimental data, and will soon be applied to other targets.

9:42 AM BF.00007 Fission-fragment properties in a microscopic approach, WALEED YOUNES, Lawrence Livermore Natl Lab — The microscopic description of fission remains one of the greatest challenges in nuclear physics. In particular, observed properties of the fission fragments (e.g., kinetic energies, emitted neutron multiplicities, etc.) are notoriously difficult to reproduce and provide a stringent test of the microscopic approach. In this talk, I will present fission-fragment properties extracted from Hartree-Fock-Bogoliubov calculations using the Gogny effective interaction for low-energy induced fission of $^{239}$Pu. This approach to fission provides a fully microscopic, self-consistent, quantum-mechanical framework where the only phenomenological input is the effective interaction between nucleons. I will discuss the formal identification of scission configurations and compare deduced fragment properties, such as excitation and kinetic energies, to experimental data.

9:54 AM BF.00008 Survival Probabilities in hot fusion reactions, WALTER LOVELAND, DONALD PETERSON, Oregon State University — The reported cross sections for the formation of superheavy elements in hot fusion reactions of $^{28}$Ca with actinide target nuclei decrease modestly in going from element 113 to element 118. This robust behavior is attributed to increasing survival probabilities of the product nuclei as one gets closer to Z = 114 or N = 184. The real situation is complicated with the fused systems starting at excitation energies of 30-50 MeV where shell effects on $\Gamma_f$, $\Gamma^*$ are not important but where dissipative effects may retard fission and ending at excitation energies where shell effects are very important. We demonstrate how these effects occur in the de-excitation of $^{252}$No excited to E* = 61 MeV by combining measurements of the neutrons emitted in this reaction with evaporation residue measurements.
10:06AM BF.00009 In-medium nucleon-nucleon scattering in reactions with rare isotopes

CARLOS BERTULANI, Texas A&M University-Commerce. K. OGATA, Kyushu University — Relativistic effects in the breakup of weakly-bound nuclei at intermediate energies are studied and compared with non-relativistic calculations. We show that relativistic corrections lead to larger breakup cross sections. Since many of these reactions can only be treated correctly if one accounts for the coupling between states in the continuum, we show that continuum-discretized coupled-channels calculations will also be strongly influenced by relativistic effects.

Friday, October 24, 2008 8:30AM - 10:18AM —
Session BG Strange Matter Jewett Ballroom C

8:30AM BG.00001 Determining the Nucleon’s Neutral Weak Axial Form Factor $G_A^{e(T=1)}$ Using Quasi-Elastic Electron Scattering from a Deuteron Target, COLLEEN ELLIS, University of Maryland, College Park, GZERO COLLABORATION — The G0 collaboration has taken data using the Jefferson Lab high-luminosity polarized electron beam to measure the parity-violating asymmetry of elastically and quasi-elastically scattered electrons from cryogenic proton and deuterium targets. This asymmetry, arising from the interference between the electromagnetic and neutral weak interactions and which may be as small as a few ppm, provides a means to determine the strange quark contribution to the proton electric and magnetic form factors, $G_E^p$ and $G_M^p$, and the neutron’s neutral weak axial form factor, $G_A^{e(T=1)}$. The asymmetry seen in quasi-elastic electron scattering from deuterium is predominantly sensitive to the isovector part of $G_A$, which is one of the dominant uncertainties in the present experimental determination of $G_E^p$ and $G_M^p$ at lower momentum transfer. The status, method, and on-going analysis of the data quality, behavior of asymmetries, and systematic errors involved in the determination of $G_A^p$ at $Q^2$ of 0.23 GeV$^2$ and 0.63 GeV$^2$ will be presented.

8:42AM BG.00002 Determining $G_E^d$ and $G_M^d$ from parity violating asymmetry measurements at $Q^2 = 0.23$, 0.63 GeV$^2$, MATHEW MUETHER, University of Illinois, G0 COLLABORATION — The G0 experiment recently utilized the high luminosity polarized electron beam at Jefferson Lab to measure parity-violating asymmetries in backward scattered electrons from cryogenic hydrogen and deuterium targets at momentum transfers, $Q^2$, of 0.23 and 0.63 GeV$^2$. These asymmetries, arising from the interference of the electromagnetic and neutral weak interactions, are only a few tens of parts-per-million. A dedicated toroidal superconducting magnetic spectrometer, and fast counting electronics provided the required particle identification and measurement precision. These data together with previous results, including the $G_0$ forward angle measurement [1], allow the determination of the strange electric and magnetic nucleon form factors, $G_E^d$ and $G_M^d$ at the respective $Q^2$ values. The current status of our analysis to determine these values will be presented. [1]D.S. Armstrong et al. (G0), Phys. Rev. Lett. 95, 092001 (2005).

8:54AM BG.00003 Searching for Strangelets in Lunar Soil at $10^{-17}$ Sensitivity Level using the Accelerator Mass Spectrometry Technique$^1$, KE HAN, Yale University, LSSS COLLABORATION — The theoretical existence of Strange Quark Matter (SQM) has been postulated for over three decades. A wide range of experimental searches for strangelets (i.e. small lumps of SQM with baryon number less than 10$^7$) have been conducted but all failed to give a definite answer to the existence of SQM. Our experiment searches for strangelets in lunar soil, where the predicted strangelet concentration is about 10$^9$ times higher than that on Earth. The lunar soil sample is accelerated to 102 MeV using the tandem Van-de-Graaff accelerator at Yale University and analyzed using the accelerator mass spectrometry technique. We find no strangelet signal in the mass range 42 to 70 amu. The single event sensitivity limit for the existence of strangelet with electric charge equal to 8, 9, or 6 (strange oxygen, fluorine, or carbon) in our covered mass range is about 10$^{-17}$ strangelet per normal atom.

$^1$the LSSS Collaboration: Alexei Chikianian, Evan Finch, Ke Han, Richard Majka, Jack Sandweiss Jeffrey Ashenfelter, Andreas Heinz, Peter Parker (Yale University, USA), Peter Fisher, Benjamin Monreal (MIT, USA), and Jes Madsen (University of Aarhus, Denmark)

9:06AM BG.00004 $\phi(1020)$ Photo-production in Neutral Decay Channel $\gamma p \rightarrow p' \phi \rightarrow p' K_S K_L$, HEGHINE SERAYDARYAN, MOSKOV AMARIAN, ODU, HOVHANNES BAGHDASARYAN, UVA, LARRY WEINSTEIN, GAGIK GAVALIAN, ODU, CLAS COLLABORATION — Using photo-production data on hydrogen target collected with CLAS detector at Thomas Jefferson National Accelerator Facility the $\phi(1020)$ meson production cross-sections in the neutral decay channel $\phi \rightarrow K_S + K_L$ is obtained for the first time. The measured cross-section shows differences from the charged channel decay ($\phi \rightarrow K^+ + K^-$). In this talk we present the cross-section and the $t$-slope for wide photon energy range $E_\gamma = 1.6$-2.6 GeV.

9:18AM BG.00005 Nuclear Transparency of Kaons (K+)$^1$, NURUZZAMAN, Mississippi State University — Quantum Chromo Dynamics (QCD) is the fundamental theory of the strong force. The transition from nucleons and mesons to the quarks and gluons of QCD can be studied by looking for the onset of phenomena predicted by QCD, such as Color Transparency (CT). CT is the disappearance of final (initial) state interactions for hadrons produced in exclusive processes at high momentum transfers. An experiment to measure the transparency of pions, in search of CT was completed in Dec 2004 at JLab in Hall C. The same set of data also has a considerable sample of kaons that can be used to study the transparency of kaons. Kaon transparency via electro-production has not been studied before and will provide useful information regarding the nature of the transition from quarks to hadrons. In addition, this data helped us investigate the anomalous strangeness transparency reported for kaon-nucleus scattering data. We have extracted the kaon transparency by comparing the electro-production of kaons from various nuclear targets to electro-production from hydrogen which is similar to the technique used to extract pion transparency. Preliminary results from this analysis will be presented.

$^1$JLAB E01107 Collaboration; This work is sponsored by U.S. Department of Energy. Grant Number:DE-FG02-07ER414528.

9:30AM BG.00006 Photoproduction of Neutral Kaons on Deuterium$^1$, KABI R. BANTAWA, D.M. MANLEY, Kent State University, THE CRYSTAL BALL AT MAMI, TAPS, AND A2 COLLABORATION — The $\gamma n \rightarrow K^0\Lambda$ reaction on a liquid deuterium target was measured in the A2 Hall of the MAMI-C electron accelerator facility at the Institüt für Kernphysik in Mainz, Germany. An incident electron beam of energy 1.5 GeV was directed on a 10-$\mu$m copper radiator to produce a bremsstrahlung photon beam that was tagged using the Glasgow Photon Tagger. The final-state $K^0$ and $\Lambda$ were identified by their decays $K^0 \rightarrow 2e^0$ and $\Lambda \rightarrow n^0\pi^0$, respectively. These three $n^0$s were reconstructed by detecting and analyzing the six photons resulting from the $n^0$ decays using the Crystal Ball multiphoton spectrometer and the TAPS detector as a forward wall. This combined detector system covered nearly 4$\pi$ in solid angle. Kinematic fitting was used to select good events. This reaction is expected to shine light on isospin-1/2 nucleon resonances in the 1.7-GeV mass range. An experimental overview and preliminary results for differential and integrated cross sections will be presented.

$^1$This work was supported in part by the U.S. DOE Grant No. DE-FG02-01ER41194.
lasers. NIF will attempt to demonstrate ICF, by which more fusion energy is released from its

Lawrence Livermore National Laboratory — NIF is within a year from completion and conducting experiments in inertial confinement fusion (ICF), stockpile

these data will address the physics of dark matter and dark energy, the possible existence of modified gravity on large scales, the neutrino mass, and possible

energy involving the deep wide-area survey will be described. By separately tracing the development of mass structure and rate of expansion of the universe,

billion galaxies will enable maps of dark matter and several independent cross-checking probes of the nature of dark energy. These and other probes of dark

UC Davis — Starting around 2014, data from the Large Synoptic Survey Telescope (LSST) will be analyzed for a wide range of phenomena. The nature of

information on the radiogenic contribution to the Earth's heat balance. Other detectors focus on reactor neutrino measurements for nuclear non-proliferation

the Sun. Some of these experiments will also measure anti-neutrinos from the decay of uranium and thorium in the Earth's crust and mantle, possibly providing

oscillation. Although the central focus of current non-accelerator neutrino experiments is still the study of neutrino properties, we are moving back to using

Berkeley — When Ray Davis first proposed the Homestake experiment, its primary mission was to study the Sun by detecting the neutrinos from solar fusion

physics as well as interesting measurements that will be possible using GlueX will be presented.

10:06AM BG.00009 The GlueX Experiment at Jefferson Lab , CURTIS MEYER, Carnegie Mellon University, THE

GLUEX COLLABORATION — The GlueX experiment is part of the Jefferson Lab 12-GeV upgrade and is a large solid angle device for the detection of photons and

charged particles. GlueX will search for gluonic excitations of mesons (exotic hybrids) using linearly polarized 9 GeV photons incident on a hydrogen target.

The experiment has been designed to be sensitive to the expected mass and decay modes of hybrid mesons. With this capability, the experiment will be able to

map out several nonets of exotic hybrids and make solid comparisons to both lattice predictions as well as other QCD-inspired model predictions. Beyond the

core program of hadron spectroscopy, the experiment will also be able to carry out measurements of photon interactions on various targets. Both the core

physics as well as interesting measurements that will be possible using GlueX will be presented.

Friday, October 24, 2008 10:30AM - 12:18PM –

Session CA Intersections of Nuclear Physics with Other Fields  Simmons Ballroom 2-3

10:30AM CA.00001 Neutrinos from Reactors, the Earth and the Sun, MICHAL PATRICK DECOWSKI, UC

Berkeley — When Ray Davis first proposed the Homestake experiment, its primary mission was to study the Sun by detecting the neutrinos from solar fusion

reactions. He probably did not expect that the neutrino deficit he detected would initiate several experiments that culminated in the discovery of neutrino

oscillation. Although the central focus of current non-accelerator neutrino experiments is still the study of neutrino properties, we are moving back to using

neutrinos as probes to investigate the processes that emit them in the first place. A number of new experiments will use neutrinos to examine the reactions inside

the Sun. Some of these experiments will also measure anti-neutrinos from the decay of uranium and thorium in the Earth’s crust and mantle, possibly providing

information on the radiogenic contribution to the Earth’s heat balance. Other detectors focus on reactor neutrino measurements for nuclear non-proliferation

purposes. In this talk I will give a survey of current and upcoming experiments that look at neutrinos from these different sources.

11:06AM CA.00002 Cosmic probes of the physics of dark matter and dark energy, TONY TYSON, UC Davis — Starting around 2014, data from the Large Synoptic Survey Telescope (LSST) will be analyzed for a wide range of phenomena. The nature of dark matter can be constrained by measuring the scales on which it clumps. The nature of dark energy can be constrained by measuring the time evolution of cosmic dark matter structures and through measurements of the distribution of galaxies and the cosmic “shear” of their apparent shapes. A sample of three billion galaxies will enable maps of dark matter and several independent cross-checking probes of the nature of dark energy. These and other probes of dark energy involving the deep wide-area survey will be described. By separately tracing the development of mass structure and rate of expansion of the universe, these data will address the physics of dark matter and dark energy, the possible existence of modified gravity on large scales, the neutrino mass, and possible self interaction of dark matter particles. Images of dark matter from our current survey will be shown, and the status of the LSST project will be reviewed.

11:42AM CA.00003 New Capability for Nuclear Physics and HED Sciences, WILLIAM H. GOLDSTEIN, Lawrence Livermore National Laboratory — NIF is within a year from completion and conducting experiments in inertial confinement fusion (ICF), stockpile stewardship, high energy density (HED) science and nuclear physics. NIF’s 192 beams will produce 1.8 MJ at 351 nm, 60 times more than the largest previous lasers. NIF will attempt to demonstrate ICF, by which more fusion energy is released from its $^2$H-$^3$H target than the NIF laser uses to compress and heat it. NIF’s three missions will study matter at extreme conditions: temperatures up to $10^7$K, densities to $1000$ g cm$^{-3}$, and pressures to $10^{16}$ Pascals. In fusion events, NIF will produce a neutron density up to $10^{21}$ cm$^{-3}$. These conditions occur only in the interiors of stars, in thermonuclear burn, and in supernovae that signal the end of massive stars’ lives. NIF’s experiments will study the parameter space of ICF as well as experiments in several HED science subfields. NIF facility time and resources will be allocated via a peer review process to be overseen by the NIF user office. This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

Friday, October 24, 2008 10:30AM - 12:18PM –

Session CB Mini-Symposium: 3D View of the Nucleon and Its Spin II  Room 208

10:30AM CB.00001 Longitudinal Spin Transfer of Hyperons in Polarized Proton-Proton Collisions¹, ERNST SICHERMANN, Lawrence Berkeley Laboratory — We report on measurements of the longitudinal spin transfer $D_{LL}$ in the inclusive production of $\Lambda$ and $\bar{\Lambda}$ hyperons in 200 GeV longitudinally polarized proton- proton collisions. At large transverse momenta $D_{LL}$ is sensitive to the helicity distributions of strange quarks and anti-quarks in the polarized proton, and to polarized fragmentation functions. The data were collected with the Solenoid Tracker At RHIC (STAR) in 2005 and correspond to a sampled integrated luminosity of $\sim 1$ pb$^{-1}$ and $\sim 50\%$ beam polarization. Preliminary results on $D_{LL}$, covering mid-rapidity and transverse hyperon momenta up to 4 GeV/c, will be presented and followed by an outlook on future hyperon spin transfer measurements.

¹On behalf of the STAR Collaboration.
11:06AM CB.00002 Constraints on $\Delta G$ from Recent Measurements of Inclusive Jet Production in Longitudinally Polarized pp Collisions at $\sqrt{s} = 200$ GeV , W.W. JACOBS, Indiana University Cyclotron Facility and Department of Physics, STAR COLLABORATION — A major goal of the RHIC spin program is to determine the gluonic spin contribution to the proton. The large acceptance of the STAR detector is particularly suited for inclusive jet measurements at 200 GeV which arise in leading order from $qq$ and dominant $gg$ hard interactions. Robust measurements of the double longitudinal spin asymmetry $A_{LL}$ sensitive to the gluon polarization are aided by the large inclusive jet cross section and relative insensitivity to fragmentation functions. Mid-rapidity $A_{LL}$ data are presented from RHIC run 5 along with the more precise results from run 6 covering a transverse momentum range $5 < P_T < 35$ GeV. Comparison of these data to predictions from parameterizations of the gluon polarization have been made and put significant new constraints on the gluon polarization contributions within the present kinematic range $0.3 < x < 0.3$ of acceptance. The STAR data and their systematics, current constraints from various prediction comparisons as well as results from inclusion of pp measurements in global analyses will be discussed.

11:18AM CB.00003 Measurement of Double Longitudinal Spin Asymmetry in Heavy Flavor Production at $\sqrt(s) = 200$ GeV at RHIC , XIAORONG WANG1, New Mexico State University, PHENIX COLLABORATION — One of the main goals of the RHIC-SPIN program is to determine the contribution of gluons to the proton spin. At RHIC energies, the heavy quark (charm and beauty) production is expected to be dominated by gluon-glue interactions, so a measurement of the double longitudinal spin asymmetry $A_{LL}$, in heavy quark production in polarized $p+p$ collisions hence allows us to directly probe the polarized gluon distribution inside the proton. The PHENIX experiment collected 3.5 pb$^{-1}$ of data with beam polarization $\sim 50\%$ and 7.5 pb$^{-1}$ of data with beam polarization $\sim 60\%$ in the years 2005 and 2006, respectively. In this talk, we present the latest results on an $A_{LL}$ measurement for $J/\psi$ and open charm production measured by the PHENIX detector.

$1^1$for the PHENIX Collaboration

11:30AM CB.00004 Longitudinal Double-Spin Asymmetry and Cross Section for Inclusive $\pi^0$ Production in Polarized $p+p$ Collisions at RHIC , OLEKSANDR GREBENYUK, LBNL, STAR COLLABORATION — Important insight into the spin structure of the nucleon is provided by studying the gluon spin contribution to the spin of proton. Recent STAR measurements of inclusive jet production provide sensitive constraints on the integral of gluon polarization $\Delta g(x, Q^2)$ for fractional gluon momenta $0.03 < x < 0.3$ and hard scales. We present measurements of the longitudinal double-spin asymmetry and differential cross section for neutral pions produced in $p+p$ collisions at $\sqrt{s} = 200$ GeV. The measured cross section is in good agreement with NLO pQCD calculations for all measured $p_T$, $2 < p_T < 16$ GeV/$c$, corresponding to seven orders in magnitude, and can provide constraints on fragmentation functions. The longitudinal double-spin asymmetry data disfavor large and positive gluon polarization in the polarized nucleon. They provide sensitive constraints that are complementary to those obtained with inclusive jet probes.

11:42AM CB.00005 On measuring the double longitudinal spin asymmetry $A_{LL}$ for non-photonic electrons in polarized $\bar{p}+p$ collisions at STAR , PRISCILLA KURNADI, UCLA, STAR COLLABORATION — The measurement of the gluon's spin structure function $\Delta g(x)$ is heavy flavor quark production through gluon fusion $gg \rightarrow q\bar{q}$. A way to access these heavy quarks is through the non-photonic electrons resulting from their semi-leptonic decays. This contribution will describe an analysis to obtain the first measurement of $A_{LL}$ for non-photonic electrons produced in \sqrt(s) = 200$ GeV $\bar{p}p$ collisions at RHIC in 2005.

11:54AM CB.00006 Future Measurements to Constrain $\Delta g(x)$ at STAR , JAMES SOWINSKI, Indiana University, STAR COLLABORATION — Understanding how the spin of the proton is assembled from the spin and orbital motion of its partons has been a long term quest of the community. It is well known that the spin of the quarks contribute only about 1/3 of the proton's spin. RHIC provides the opportunity to look directly at the distribution of gluon spins in the proton via hard partonic processes in high energy polarized $pp$ collisions. Recent STAR measurements along with others, have demonstrated that the gluons also do not make large contributions above a partonic momentum fraction $x \sim 0.02$. However a better understanding of the $x$ dependence of the gluon contribution, $\Delta g(x)$, and its extension to lower $x$ values, all at higher precision, are required to determine the integral contribution $\Delta G$. Additional measurements are planned to utilize the large acceptance of STAR along with detection of di-jet and photon-jet correlations to gain sensitivity to the $x$ dependence. Recent additions in calorimetry allow extension of the measurements down to near $10^{-3}$ in $x$. Improvements of beam luminosity and polarization as well as runs at $\sqrt(s) = 200$ and 500 GeV/$c^2$ are expected. The planned measurements will be described and projections of their implications for our understanding of the gluon's contribution to the proton spin will be presented.


12:06PM CB.00007 Photon and $\gamma$-Jet Reconstruction in the STAR Endcap EMC; Towards $\gamma$-Jet Constraints on $\Delta G$ , W.W. JACOBS, Indiana University Cyclotron Facility and Department of Physics, STAR COLLABORATION — The goal of determining the gluonic spin contribution to the proton is central to RHIC spin efforts. Recent results from inclusive jet measurements in polarized pp collisions at STAR and other experiments have indicated that gluons with momentum fraction $x$ above $\sim 0.02$ do not contribute significantly to the integral $\Delta G$. $\gamma$-jet measurements provide a simpler although much more rare probe of the gluon spin contribution with sensitivity to the $x$ dependence (event reconstruction of partonic kinematics) through measurements of the double longitudinal spin asymmetry $A_{LL}$. Several factors enhance the figure of merit of the primary gluon Compton process ($g+q \rightarrow q+\gamma$) for these measurements in the Endcap and the detector itself was built to address various experimental difficulties, including suppressing the large $n^2$ backgrounds that grow at lower momentum transfer. The status of ongoing photon, direct $\gamma$ and $\gamma$-jet reconstruction and analyses efforts from the run 6 $pp$ data sample and future prospects will be presented and discussed.

Friday, October 24, 2008 10:30AM - 12:18PM
Session CC Mini-Symposium: Applications of Nuclear Physics from Earth to Outer Space  Jewett Ballroom A-B
10:30AM CC.00001 Nuclear Physics and Radiobiology - Issues for Humans in Space and on Earth, RAM TRIPATHI, NASA Langley Research Center — Nuclear physics is playing a vital role in human biological applications, specifically in planned space missions, in hadron radiotherapy, and in low dose radiobiology. While seemingly disparate, these and other areas share a common need for the understanding of nuclear interactions in biological systems. Radiobiology continues to provide valuable information that will help develop better methods for using radiation in the treatment of disease as well as provide a scientific basis for radiation protection standards. NASA is now focused on the agency’s vision for space exploration encompassing a broad range of human and robotic missions including missions to the Moon, Mars and beyond. As a result, there is a focus on long duration space missions. Protection from hazards of space radiation has been identified as one of the five NASA critical areas for human space flight. The cost effective design of spacecraft demands a very stringent requirement on the optimization process. Exposures from the hazards of severe space radiation in deep space and/or long duration missions are very different from that of low earth orbit, and much needs to be done about their effects. However, it is clear that revolutionary technologies will need to be developed. Here on earth, particulate radiation treatment for cancer, such as proton radiotherapy, is playing an increasing role with the advent of proton and heavy-ion treatment centers. Advanced imaging, dosimetric, Monte Carlo, and other techniques from nuclear physics are utilized to study the molecular basis of fractionation dependency and other tumor and normal tissue radiation responses, such as radiosensitivity. Moreover, advances developed by biological research efforts, such as the sequencing of the human genome, have opened new horizons for radiobiology. New techniques have made it possible to determine at the cellular / molecular level how living systems respond even to low doses of radiation. I will discuss the interplay between nuclear physics and human biological applications; Starting with high dose exposure in space applications, to controlled exposure in radiotherapy, and finally, low dose radiobiology. I will project how cellular level living system activities may provide the much needed insight of radiation exposure on living tissues in these applications.

11:06AM CC.00002 Quantitative and Qualitative Differences in Neurocognitive Impairment Induced by 1 GeV 56Fe Ions and X-Rays1, R. BRITTEN, S. MITCHELL, B. PARRIS, A. JOHNSON, Eastern Virginia Medical School, S. SINGLETARY-BRITTEN, National Institutes of Aging, G. LONART, R. DRAKE, Eastern Virginia Medical School — During the planned mission to Mars, Astronauts will be exposed to heavy charged particles (HZE). Our group has been determining the relative biological effectiveness (RBE) of Hze (1 GeV 56Fe, LET = 150 kev/μm) with respect to neurocognitive impairment, specifically spatial memory, short-term working memory and attentional set shifting. Our current data suggest that Hze have RBE values of about 7 for hippocampal-dependent spatial memory tasks (Barnes Maze) and possibly even higher for certain attentional processes. We have also used MALDI-TOF serum profiling analysis to identify several proteins that are biomarkers of both the level and LET of radiation exposure. From a mission perspective, attentional set shifting is the neurocognitive function most likely to be impacted by the predicted Hze radiation exposure, and biomarkers of cognitive performance. Our data suggest that Hze particles have a distinctly different impact upon neurocognitive function in rats than do X-rays. From a mission perspective, attentional set shifting is the neurocognitive function most likely to be impacted by the predicted Hze exposure; unfortunately Set shifting underlies our ability to execute complex plans. The proteins identified could be used to monitor the Astronauts for radiation exposure and any associated loss of neurocognitive function, and some may actually give an insight into the complex processes that lead to radiation-induced cognitive impairment.

1The authors gratefully acknowledge grant support from NASA (NNJ06ZSA001N).

11:18AM CC.00003 Biologically Optimized Treatments for Hadron Radiotherapy, VAHAGN NAZARYAN, CYNTHIA KEPPEL, Hampton University, RICHARD BRITTEN, Eastern Virginia Medical School, JERRY GEORGE, XILIANG NIE, Hampton University — Near future advances in proton radiotherapy technology will increasingly require complex, conformal treatment planning. However, the current state of knowledge of the biological efficiency of proton beams may be inadequate to facilitate precision, and reduced margins. A new project at the Hampton University Proton Therapy Institute and the Eastern Virginia Medical School aims to facilitate the expected benefits of increasingly conformal treatment capabilities. Specifically, we seek to establish with measurements the biological depth dose profile of protons with incident energies in the range 62-210 MeV, and to utilize these also to provide vastly improved model algorithms for patient treatment planning based on biological, rather than simply physical, depth dose profiles. A progress report on a model for proton biological efficiency calculations as an input algorithm for treatment planning with protons will be presented. The planned measurements will be discussed.

1Research support received from Varian Medical Systems, Inc., and Virginia Commonwealth Technology Research Fund.

11:30AM CC.00004 Variation of Space Radiation Exposure inside Spherical and Hemispherical Geometries, ZI-WEI LIN, East Carolina University, YOUNES BAALLA, The University of Tennessee Space Institute, LAWRENCE TOWNSEND, University of Tennessee at Knoxville — We calculate the space radiation exposure to blood-forming organs everywhere inside a hemispherical dome that represents a lunar habitat. We derive the analytical path length distribution from any point inside a hemispherical or a spherical shell. Because the average path length increases with the distance from the center, the center of the hemispherical dome on the lunar surface has the largest radiation exposure while locations on the inner surface of the dome have the lowest exposure. This conclusion differs from an earlier study on a hemispherical dome but agrees with another earlier study on a spherical-shell shield. We also find that the reduction in the radiation exposure from the center to the inner edge of the dome can be as large as a factor of 3 or more for the radiation from solar particle events while being smaller for the radiation from galactic cosmic rays.

11:42AM CC.00005 Space and Medical Applications of the Geant4 Simulation Toolkit, JOSEPH PERL, Stanford Linear Accelerator Center — Geant4 is a toolkit to simulate the passage of particles through matter. While Geant4 was developed for High Energy Physics (HEP), applications now include Nuclear, Medical, and Space Physics. Medical applications have been increasing rapidly due to the overall growth of Monte Carlo in Medical Physics and the unique qualities of Geant4 as an all-particle code able to handle complex geometry, motion and fields with the flexibility of modern programming and an open free source code. Work has included characterizing beams and sources, treatment planning and imaging. The all-particle nature of Geant4 has made it popular for the newest modes of radiation treatment: Proton and Particle therapy. Geant4 has been used by ESA, NASA and JAXA to study radiation effects to spacecraft and personnel. The flexibility of Geant4 has enabled teams to incorporate it into their own applications (SPENVIS MULASSIS space environment from QinetiQ and ESA, RADSAFE simulation from Vanderbilt University and NASA). We provide an overview of applications and discuss how Geant4 has responded to specific challenges of moving from HEP to Medical and Space Physics, including recent work to extend Geant4’s energy range to low dose radiobiology.

11:54AM CC.00006 Radiometric Meteorology: radon progeny as tracers, MARK GREENFIELD, ATSUSHI IWATA, NAHOKO ITO, KENYA KUBO, Intnrl Christian Univ, KAZU KOMURA, LLRL - Kanazawa Univ, MIHO ISHIZAKI, Tohoku Univ — In-situ measurement of atmospheric γ radiation from radon progeny determine rain and snow better than standard rain gauges and gives a handle on how droplets are formed. The measured γ ray rates (GRR) have been shown to be proportional to a power of radiometric precipitation rates (RPR)α, α giving a handle on the extent to which radon progeny are surface adsorbed or volume absorbed. More recently time dependent ratios of GRR from 214Pb and 214Bi, concentrated from collected rainwater, have been used to determine the elapsed time since activity from RPR, adhered to rain droplets, was removed from secular equilibrium. Ion exchange resins precipitate out the 214Pb and 214Bi ions, which are then filtered from 10s of liters of rainwater or snowmelt. A portable Ge detector is used to integrate the resulting activity over 5-10 min intervals. The measured evolution of these two activities from secular equilibrium to transient equilibrium has meteorological applications enabling both the determination of average elapsed times between the formation of raindrops and the time they reach the ground, as well as an estimate of the initial activity at the source of droplet formation.

12:06PM CC.00007 Nuclear Resonance Fluorescence from $^{238}$U$^1$, S. HAMMOND, C.T. ANGELL, H.J. KARWOWSKI, University of North Carolina-Chapel Hill & TUNL, C.R. HOWELL, E. KWAN, G. RUSEV, A. TONCHEV, W. TORNOW, Duke University & TUNL, J.H. KELLEY, NCSU & TUNL. — Nuclear resonance fluorescence provides unambiguous isotope identification by observing de-excitations of nuclear levels of γ-ray transitions characteristic of the isotope of interest as high-energy γ-rays penetrate protective shielding, acting as an identifier of hidden nuclear materials. Using the mono-energetic γ-ray source at the H, S facility to investigate the nucleus $^{238}$U through the (γ, γ') reaction, we measured the widths of low-spin states observed at incident γ-ray beam energies in the range of 2.94 to 4.40 MeV.

This work was supported in part by NSF/DHS grant CBET-0736123.

Friday, October 24, 2008 10:30AM - 12:18PM — Session CD Mini-Symposium: Rare Isotope Science II. Jewett Ballroom G-H

10:30AM CD.00001 Elucidation of complex decay schemes using on-line mass separated sources and a large array of Compton-suppressed germanium detectors$^1$, N. BROWN, J.L. WOOD, W.D. KULP, D. FURSE, Georgia Institute of Technology, G.A. DEMAND, P.E. GARRETT, K.L. GREEN, G.F. GRINYER, K.G. LEACH, A.A. PHILLIPS, M.A. SCHUMAKER, C.E. SVENSSON, J. WONG, University of Guelph, G.C. BALL, D.S. BANDYOPADHYAY, G. HACKMAN, A.C. MORTON, C.J. PEARSON, TRIUMF, R.A.E. AUSTIN, S. COLOSIMO, St Mary’s University, S.W. YATES, University of Kentucky, D. CROSS, Simon Fraser University, THE 8 PI COLLABORATION. — Complex decay scheme construction using beta decay of isotopes produced by spallation and mass separation on-line at TRIUMF-ISAC and studied with the 8π array of 20 Compton-suppressed germanium detectors is described. Results from the analysis of the $^{160}$Yb → $^{160}$Tm decay will be presented. Emphasis will be placed on the sensitivity to weak decay branches, assignment of γ-ray lines to isobars, and the use of conversion electron coincidences to observe low-energy transitions. The goal of this work is to achieve detailed decay scheme spectroscopy far from stability with the same level of detail as obtained with the 8π array near stability in earlier $N = 90$ studies [1] [2].

1 This work was supported in part by US DOE grant No. DE-FG02-96ERAR0958.

10:42AM CD.00002 A novel approach for determining level schemes from γ-ray coincidence data. G.A. DEMAND, P.E. GARRETT, K.L. GREEN, K.G. LEACH, A.A. PHILLIPS, M.A. SCHUMAKER, C.E. SVENSSON, J. WONG, University of Guelph, G.C. BALL, D. BANDYOPADHYAY, G. HACKMAN, A.C. MORTON, C.J. PEARSON, TRIUMF, R.A.E. AUSTIN, S. COLOSIMO, St Mary’s University, J.L. WOOD, W.D. KULP, D. FURSE, N. BROWN, Georgia Tech, G.F. GRINYER, NSCL/MSU, S.W. YATES, University of Kentucky, D. CROSS, Simon Fraser University. — Nuclear structure studies often rely on understanding trends amongst the excited states of large numbers of nuclei. Experiments performed using powerful γ-ray spectrometers, like GAMMASPHERE or the 8π array, can often reveal many hundreds of transitions in the nuclei of interest. As a result, the determination of level schemes and the precise calculation of the associated properties, such as transition branching ratios, can become a substantial obstacle to the rapid development and formulation of new ideas. Recent increases in computational power, while insufficient to solve the problem by brute force, make an algorithmic approach possible. We will present results of applying a new algorithm based on evolutionary computation to γ-ray coincidence data obtained from β-decay studies of $^{112}$Ag and $^{160}$Tm, using the 8π array at TRIUMF-ISAC, to demonstrate the usefulness of this approach for nuclear structure studies. Work supported in part by NSERC.

10:54AM CD.00003 β-delayed p-decay of proton-rich nuclei $^{23}$Al and $^{31}$C1 and explosive H-burning in novae$^1$, L. TRACHE, A. BANU, J.C. HARDY, M. MCCLESKEY, E. SIMMONS, G. TABACARU, R.E. TRIBBLE, Texas A&M University, J. AYSTO, A. JOKINEN, A. SAASTAMOINEN, Univ. of Jyvaskyla, Finland, T. DAVINSON, P.J. WOODS, Univ. of Edinburgh, UK, L. ACHOURI, B. ROEDER, LPC Caen, France. — We developed a technique to measure β-delayed proton-decay of proton-rich nuclei produced and separated with MARS at TAMU. In particular, we studied the decay of $^{23}$Al and $^{31}$Cl, both important for understanding explosive H-burning in novae. We have pulsed the beam, implanting the source nuclei moving at about 40 MeV/u in a thin Si strip detector, and then measured β-p and β-γ coincidences simultaneously. The states populated above the proton threshold in $^{23}$Mg and $^{31}$S, respectively, may proton decay. They are resonances in the reaction $^{22}$Na(p,γ)$^{23}$Mg (crucial for the depletion of $^{22}$Na in ONe novae) and in $^{30}$P(p,γ)$^{31}$S (critical point in explosive H-burning in novae), but the protons emitted have very low energies, starting at about 200 keV, an experimental challenge. The setup and the results are described. The β-decay schemes were established for both nuclei, and IAS identified. The technique has shown a remarkable selectivity to β-delayed charged particle emission and shown to work even at radioactive beam rates of a few pps, for rare isotopes with lifetimes as low as 10s msec.

1 Supported by US DOE.

11:06AM CD.00004 First Direct Measurement of the $^{17}$F(p,γ)$^{18}$Ne Cross Section$^1$, K.A. CHIPPS, U. GREEFE, Colorado School of Mines, D.W. BARDAYAN, C.D. NESARAJA, S.D. PAIN, M.S. SMITH, Oak Ridge National Laboratory, J.C. BLACKMON, Louisiana State University, K.Y. CHAE, B.H. MOAZEN, S.T. PITTMAN, University of Tennessee Knoxville, R. HATARIK, W.A. PETERS, Rutgers University, R.L. KOZUB, J.F. SHRINER, Tennessee Technological University, C. MATEI, Oak Ridge Associated Universities. — The rate of the $^{17}$F(p,γ)$^{18}$Ne reaction is of significant importance in astrophysical events like novae and x-ray bursts. A 3$^+$ state in $^{18}$Ne predicted to dominate the rate was found at 599.8 keV using the $^{17}$F(p,p)$^{17}$F reaction [1], but the resonance strength was unknown. For the first time, the $^{17}$F(p,γ)$^{18}$Ne reaction has been measured directly with the Daresbury Recoil Separator, using a mixed beam of radioactive $^{17}$F and stable $^{17}$O from the HRIBF at ORNL. Resonant proton capture cross sections, γ widths, and resonance strengths for the 599.8 keV and 1178 keV resonances will be reported, as well as an upper limit on the direct capture cross section at an intermediate energy. [1] Bardayan et al., Phys. Rev. C 62 055804 (2000).

1 This work is supported by the US DOE.
11:18AM CD.00005 Beta Decay Half-life of 84Mo\textsuperscript{1} — J.B. STOKER, P.F. MANTICA, D. BAZIN, A. BICKLEY, A. BERCERRIL, H. CRAWFORD, K. CRUSE, A. ESTRADE, M. MOBLY, C.J. GUESS, G.W. HITT, G. LORUSSO, M. MATOS, R. MEHARCHAND, K. MINAMISONO, F. MONTES, J. PEREIRA, G. PERDIKAKIS, J.S. PINTER, H. SCHATZ, J. VREDEVVOUD, R.G.T. ZEGERS, NSCL/MSU — The $\beta$-decay half-life of 84Mo governs leakage out of the Zr-Nb cycle, a high temperature rp-process endpoint in x-ray binaries \cite{1}. Treatment of the background and the poor statistics accumulated during the previous half-life measurement leave questions about statistical and systematic errors. We have remeasured the half-life of 84Mo using a concerted setup of the NSCL $\beta$-Counting System \cite{3} and 16 detectors from the Segmented Germanium Array \cite{4}. We will report the half-life for 84Mo, deduced using 40 times the previous sample size. The application of the NSCL RF Fragment Separator to remove unwanted isotopes, and hence reduce background for the half-life measurement, will also be discussed \cite{1} H. Schatz et al., Phys. Rep. 294, 167 1998 \cite{2} P. Kienle et al., Prog. Part. Nuc. Phys. 46, 73 2001 \cite{3} J. Prisciandaro et al., NIM A 505, 140 2003 \cite{4} W. Mueller et al., NIM A 466, 492 2001 \cite{5} D. Gorlov et al. PAC 2005, Knoxville, TN, May 16-20

\textsuperscript{1}This work supported by NSF grants PHY-06-06007 and PHY-05-20930 and JINA grant PHY-02-16783

11:30AM CD.00006 $\beta$-Decay Study of the rp-Process Nucleus $^{96}$Cd\textsuperscript{2} — ANA BERCERRIL, A. AMTHOR, T. BAUMAN, D. BAZIN, H. CRAWFORD, A. ESTRADE, A. CADE, T. GINTER, C. GUESS, M. HAUSMANN, G. HITT, G. LORUSSO, P. MANTICA, M. MATOS, R. MEHARCHAND, K. MINAMISONO, F. MONTES, J. PEREIRA, G. PERDIKAKIS, J. PINTER, M. PORTILLO, H. SCHATZ, K. SMITH, J. STOKER, R. ZEGERS, National Superconducting Cyclotron Laboratory — The half-life of $^{96}$Cd, one of the major waiting points along the reaction path of the rp-process \cite{1} has been measured at NSCL. Nuclei of interest were produced by fragmentation of a 120 MeV/u $^{112}$Sn primary beam on a Be target and selected with the A1900 fragment separator in conjunction with the RF Fragment Separator \cite{2}. The experimental setup, which consisted on the NSCL $\beta$-Counting System \cite{3} and the Segmented Germanium Array \cite{4}, permitted the correlation of implants and decays as well as the detection of both prompt and $\beta$-delayed $\gamma$-rays from implanted ions. Details of the experiment and results will be presented and their implications discussed. \cite{1} H. Schatz et al., Phys. Rep. 294, 167 1998 \cite{2} D. Gorlov et al. PAC 2005, Knoxville, TN, May 16-20 \cite{3} J. Prisciandaro et al., NIM A 505, 140 2003 \cite{4} W. Mueller et al., NIM A 466, 492 2001

\textsuperscript{2}This work is supported by NSF grants PHY-06-06007 and PHY-02-16783

11:42AM CD.00007 Astrophysically Interesting Resonances; Another Approach\textsuperscript{3} — ROBY AUSTIN, Saint Mary’s University, DAVID JENKINS, University Of York — R.A.E. Austin, R. Kanungo, A. Campbell, S. Colonimo, S. Rees Saint Mary’s University; D.G. Jenkins, I.A. Diget, A. Robinson, University of York, UK; P.J. Woods T. Davinson University of Edinburgh; C.-Y. Wu A. Hurst J.A. Becker Lawrence Livermore National Laboratory; G.C. Ball M. Djongolov G. Hackman A.C. Morton, C. Pearson, S.J. Williams TRIUMF; A.A. Phillips, M. Schumaker, University of Guelph H. Boston, A. Grint, D. Oxley, University of Liverpool; D. Cline, A. Hayes, University of Rochester; We describe a prototype experiment to measure resonances of interest in astrophysical reactions. We use the TIGRESS to detect gamma rays in coincidence with charged particles, inelastically scattered in inverse kinematics. The particles are detected with the Bambino detector modified to a ΔE-ΔE silicon telescope spanning 15-40 degrees in the lab.

\textsuperscript{3}This work is supported by NSERC, STFC, DOE

11:54AM CD.00008 Reactions and Coulex at TRIUMF, progress and prospects of SHARC — CHRISTIAN A.A. DIGET, University of York, Helsington, York, United Kingdom; FRED SARAZIN, Colorado School of Mines, SHARC COLLABORATION — The Silicon Highly-segmented Array for Reactions and Coulex (SHARC) is a multi-purpose array for charged-particle detection. The array is designed to have high spatial resolution, a large solid angle coverage, and particle identification of the measured reaction products. This combination offers unique capabilities when integrated with the TIGRESS gamma-ray detectors and the post-accelerated beams at the ISAC-II facility at TRIUMF, Canada. Two major research programs will gain significantly from the utilization of SHARC: Reaction studies with particular emphasis on transfer reactions used to indirectly probe nuclear reaction rates important for explosive stellar scenarios as well as nuclear structure studies in which Coulomb excitation will play an important role. The project is funded by the UK-STFC and is lead from the University of York with collaborators from the UK Universities of Birmingham, Liverpool, Manchester, and Surrey, and Daresbury Laboratory, Colorado School of Mines and Louisiana State University of the USA; and from Canada: TRIUMF as well as McMaster, Saint Mary’s, and Simon Fraser Universities.

12:06PM CD.00009 Commissioning of the HELIOS Spectrometer at ATLAS\textsuperscript{4} — J.C. LIGHTHALL, Western Michigan University, HELIOS COLLABORATION — The HELICal Orbit Spectrometer (HELIOS) at the ATLAS facility of Argonne National Laboratory is designed to study inverse-kinematic nucleon transfer reactions using exotic beams. These reactions are of particular interest for nuclear structure away from stability and for nuclear astrophysics. The spectrometer features a 3 Tesla, 90 cm bore superconducting solenoid. Inside the HELIOS solenoid is a hollow detector array aligned with the magnetic field axis, in line with the target. This unique detector geometry has significant advantages over conventional detectors. To demonstrate its principle of operation, HELIOS will be commissioned by studying the well-known $^{2}$H($^{28}$Si,$^{1}$p)$^{29}$Si reaction in inverse kinematics at a bombarding energy of 8 MeV/u. The level density of the residual $^{29}$Si nucleus makes this reaction well suited for demonstrating the resolution and acceptance properties of the spectrometer. Experimental results will be presented.

\textsuperscript{4}Work supported by the U. S. Department of Energy, Office of Nuclear Physics, under contract numbers DE-FG02-04ER41320 (WMU) and DE-AC02-06CH11357 (ANL).

Western Michigan University, Argonne National Laboratory, University of Manchester

Friday, October 24, 2008 10:30AM - 11:54AM — Session CE Fundamental Neutron Physics Measurements — Simmons Ballroom 1

11:30AM CE.00001 ABSTRACT WITHDRAWN

10:42AM CE.00002 Measurement of the Neutron Beta Decay Asymmetry by the UCNA Experiment — MICHAEL MENDENHALL, UCNA Collaboration — In free neutron beta decay, the direction of the emitted electron is correlated with the polarization of the decaying neutron. The asymmetry between spin-aligned and spin-antialigned electron emissions is a function of $\lambda$, the ratio of axial-vector and vector coupling constants. Together with the neutron lifetime, $\lambda$ can be used to determine $V_{ud}$ in the CKM matrix. Ultracold neutrons (UCN) are advantageous for measuring the decay asymmetry as they can be nearly 100% polarized and minimize production of neutron-induced backgrounds. Presented here are results from the first measurement of the asymmetry using UCN, performed by the UCNA collaboration in 2007, and improvements for the higher-statistics measurements of this year.
11:06AM CE.00004 Ultracold Neutron Nonimaging Optics, KEVIN P. HICKERSON, Caltech — The design principles of nonimaging optics are applied to ultracold neutron (UCN) transport. In particular, a vertical compound parabolic concentrator (CPC) that efficiently redirects UCN vertically into a bounded spatial volume where they have a maximum energy \( n g a \) that depends only on the initial phase space cross sectional area \( \pi a^2 \) creates a spectrometer which can be applied to neutron lifetime experiments, gravitational quantum state experiments and nii oscillation searches.

11:18AM CE.00005 Measuring the Neutron Lifetime Using Magnetically Trapped Ultracold Neutrons, H P. MUMM, K. J. COAKLEY, A. K. THOMPSON, G. YANG, National Institute of Standards and Technology, R. GOLUB, P. R. HUFFMAN, C. M. O’SHAUGHNESSY, K. W. SCHELHAMMER, P. SEO, North Carolina State University, J. M. DOYLE, Harvard University, L. YANG, Stanford University, S. K. LAMOREAUX, Yale University — The neutron beta-decay lifetime is important in both theoretical predictions of the primordial abundance of \( ^3\text{He} \) and providing a strong unitarity test of the CKM mixing matrix. We have previously demonstrated trapping of Ultracold Neutrons (UCN) in a magnetic trap, and, though statistically limited, measured a lifetime consistent with the world average. A major upgrade of the apparatus is nearing completion at NIST. In our unique approach, a 8.9 Angstrom neutron beam is incident on a superfluid \( ^4\text{He} \) target within the minimum field region of an Ioffe-type magnetic trap. Some neutrons are backscattered by single phonon emission in the superfluid helium to near rest and trapped; at sufficiently low temperatures, the low phonon density in the helium suppresses upscatter. The electron accompanying neutron decay produces scintillation in the superfluid helium and can be detected in real time. Statistical limitations of the previous apparatus as well as systematics related to neutron material bottling will be reduced by significant increases in field strength and trap volume. Tests of a new magnetic trap, cryostat, and details of the upgrade will be presented.

11:30AM CE.00006 \( ^3\text{He} \) Relaxation Time Measurement at \( ~400\text{mK} \) for the neutron electric dipole moment (nEDM) experiment, QIANG YE, Duke University, FRANKLIN DUBOSE, NCSU, DIPANGKAR DUTTA, Mississippi State University, HAIYAN GAO, Duke University, ROBERT GOLUB, PAUL HUFFMAN, NCSU, NEDM COLLABORATION — In the new neutron electric dipole moment (nEDM) experiment which is planned to be carried out at the SNS, the neutron storage cell will be made of dTPB-dPS (a wavelength shifting material) coated acrylic and filled with superfluid \( ^4\text{He} \). The experiment will use the nuclear magnetic resonance technique to measure the neutron precession frequency by comparing with that of the polarized \( ^3\text{He} \) using spin dependence of the nuclear absorption process: \( \vec{p} \rightarrow ^3\text{He} \rightarrow p + t + 764 \text{ keV} \). The polarized \( ^3\text{He} \) will be used as a co-magnetometer to monitor the magnetic field in situ during the experiment. Understanding the relaxation mechanism of polarized \( ^3\text{He} \) in the storage cell under the experimental conditions and maintaining \( ^3\text{He} \) polarization is crucial. Following our earlier study of the \( ^3\text{He} \) relaxation time in a dTPB-dPS coated cylindrical acrylic cell at a temperature of 1.9K in the presence of superfluid \( ^4\text{He} \) at a magnetic holding field of 21 gauss, similar measurements at \( ~400\text{mK} \) (the proposed nEDM experimental temperature) have been carried out using a dilution refrigerator at TUNL with the magnetic holding field of \( ~7 \text{ gauss} \). Preliminary results will be presented.

This work is supported in part by the U.S. Department of Energy under contract number DE-FG02-03ER41231.

11:42AM CE.00007 A New Gravito-Magnetic Trap for Measuring the Neutron Lifetime using Ultracold Neutrons, KEVIN HICKERSON, Caltech, UCN LIFETIME COLLABORATION — Presently, there is a significant discrepancy between the previous most precise measurements of the neutron lifetime. To help resolve this, a new lifetime experiment is underway at the Los Alamos Neutron Science Center (LANSCE) using ultracold neutrons (UCN). Polarized UCN will be trapped by gravity in an asymmetric compound toroidal magnetic trap. The trap will be made of permanent magnets arranged in a high field gradient configuration called a Halbach array. The compound toroid combined with the rippled multipole field will quickly reduce the fraction of phase space of the trap that is quasi-bound, decreasing the probability that UCN escape or have material interactions during the lifetime measuring period. Removing these marginally trapped UCN addresses an important systematic effect in previous measurements.

Friday, October 24, 2008 10:30AM - 12:30PM —

Session CF Experimental Methods at RHIC and the LHC — Simmons Ballroom 4

10:30AM CF.00001 High-density QCD with CMS at the LHC, HAIDONG LIU, UC davis, CMS COLLABORATION — We will present the capabilities of the Compact Muon Solenoid (CMS) experiment to explore the rich heavy-ion physics programme offered by the CERN Large Hadron Collider (LHC). The collisions of lead nuclei at energies \( \sqrt{s_{NN}} = 5.5 \text{ TeV} \) will probe quark and gluon matter at unprecedented values of energy density. The prime goal of this research is to study the fundamental theory of the strong interaction — Quantum Chromodynamics (QCD) — in extreme conditions of temperature, density and parton momentum fraction (low-\( x \)). This presentation will cover in detail the potential of CMS to carry out a series of representative Pb-Pb measurements. These include "bulk" observables — charged hadron multiplicities, low \( p_T \), inclusive hadron identified spectra and elliptic flow — which provide information on the collective properties of the system; as well as perturbative processes — such as quarkonia, heavy-quarks, jets, \( \gamma\)-jet, and high \( p_T \) hadrons — which yield "tomographic" information on the hottest and densest phases of the reaction.

10:42AM CF.00002 ATLAS Jet Reconstruction Capabilities in Heavy Ion Collisions, AARON ANGERAMI, Columbia University, ATLAS COLLABORATION — High \( p_T \) jets provide a unique tool for understanding the medium induced energy loss of the nuclear matter created in heavy ion collisions. The large acceptance of the ATLAS detector as well as recent advances in jet reconstruction algorithms have created a prime opportunity for jet physics in heavy ion collisions at the LHC. In this talk I will present results on the performance of the ATLAS jet reconstruction in Pb-Pb collisions. I will summarize a systematic program of treating the large background present in these collisions as well as the capabilities of different algorithms.
10:54AM CF.00003 PHENIX Silicon Vertex Detector (VTX) Upgrade Performance Capabilities , RICHARD PETTI, Stonybrook University, PHENIX COLLABORATION — A silicon vertex detector upgrade is being developed for use in the PHENIX detector at the Relativistic Heavy Ion Collider (RHIC) located at Brookhaven National Lab (BNL). This detector features four layers to enable charged particle tracking near the collision vertex. The inner two layers (sitting at radius of 2.5cm and 5.0cm from the beam line) are constructed of pixel sensors, where as the outer two layers (at 10cm and 14cm) are of a novel stripixel design. This upgrade will significantly improve the collision vertex resolution of PHENIX. This allows us to detect off-vertex decays and to separate charm and bottom decays by the DCA (Distance of Closest Approach) resolution. The DCA is calculated by first identifying electron tracks in the PHENIX central arms and projecting the track back to track candidates in the VTX. Then the matching VTX track can be traced back towards the collision vertex and the point at which the distance between the collision vertex and the helical track is smallest can be found. Results on charm/bottom separation from a full Monte Carlo simulation will be presented.

11:06AM CF.00004 Testing of the PHENIX Silicon Pixel Detector at Fermi National Laboratory , NICOLE APADULA, Stony Brook University, PHENIX COLLABORATION — The Silicon Vertex Tracker (VTX) is a new upgrade to PHENIX at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory (BNL). The VTX is composed of two layers of a silicon pixel detector and two layers of a silicon strip detector. The innermost layers, at 2.5cm and 5cm from the beam line, consist of silicon pixel sensors capable of reconstructing tracks and achieving good DCA (Distance of Closest Approach) resolution. The DCA is the smallest distance between the collision vertex found by the VTX and the track reconstructed from the PHENIX central arms. Good DCA resolution will allow a clean identification of charm and bottom decays. This is accomplished with a 50 x 425 μm² cell size and low material budget to avoid multiple scattering. Three layers of the Silicon Pixel Detector will be placed in a test beam at Fermi National Laboratory (FNAL) to check tracking capabilities and efficiencies. The results will be presented.

11:18AM CF.00005 Zero bias and HF-based minimum bias triggering for pp collisions at 14 TeV in CMS , JEREMY CALLNER, University of Illinois at Chicago, CMS COLLABORATION — The start of LHC running and the corresponding initial low luminosities during ramp-up to full luminosity represent a unique, and possible one time, opportunity to obtain a significant amount of usable minimum bias pp data without the added complications and potential biases associated with data containing multiple collisions per bunch crossing. Important considerations need to be taken into account in the design of the trigger system to enable the effective recording of relevant minimum bias events. A description of two possible triggering schemes for minimum bias collisions will be presented. One based on a zero bias crossing-time trigger for specific luminosity situations and the second, a detector trigger based on HF, the forward calorimeters in CMS. Possible biases imposed on the data at the triggering level and ways to reject (or accept) beam gas collisions will also be discussed.

1Work partially supported by US DOE Grant DE-FG02-94ER40865.

11:30AM CF.00006 The STAR Forward GEM Tracker , JAN BALEWSKY, Massachusetts Institute of Technology, STAR COLLABORATION — The STAR collaboration is preparing a tracking detector upgrade, the Heavy Flavor Tracker (HFT) [1] and the Forward GEM Tracker (FGT) to further investigate fundamental properties of the new state of strongly interacting matter produced in relativistic-heavy ion collisions at RHIC and to provide fundamental studies of the proton spin structure and dynamics in high-energy polarized proton-proton collisions at RHIC. The FGT will focus on novel spin physics measurements in high-energy polarized proton-proton collisions, determining the flavor dependence (Δu versus Δd) of the polarized sea. STAR plans to probe these PDFs using parity violating W production and decay. W(−+) bosons are produced in u+d(d+u) collisions and can be detected through their leptonic decays, e−+νe(c−+νc), where only the respective charged lepton is measured. The sensitivity of those measurements is enhanced in the forward direction. The discrimination of u+d(d+u) quark combinations requires distinguishing between high pT e−(+) through their opposite charge sign. An upgrade of the STAR forward tracking system is needed to provide the required tracking precision for charge sign discrimination. This upgrade will consist of six triple-GEM detectors with two dimensional readout arranged in disks along the beam axis. The FGT design and installation schedule will be presented.

11:42AM CF.00007 A Very High Momentum Particle Identification Detector for Alice , EDMUNDO GARCIA, Chicago State University, VHMPID PROTO COLLABORATION — The anomalies observed at RHIC for the baryon - meson ratios have prompted a number of theoretical works on the nature of the the hadronisation stage of the pp collisions and in the evolution of the dense system formed in heavy ion collisions. Although the predictions differ in the theoretical approach, generally a substantial increase in the baryon production is predicted in the range 10-30 GeV/c. This raises the problem of baryon identification to much higher momenta than originally planned in the LHC experiments. After a review of the present status of theoretical predictions we will present thepossibilities of a gas ring imaging Cherenkov detector of limited acceptance. The physics capabilities of such a detector in conjunction with the ALICE experiment will be contemplated as well as the triggering options to enrich the sample of interesting events with a dedicated trigger or/and using the ALICE Electromagnetic Calorimeter. The use of the electromagnetic calorimeter opens interesting possibility to distinguish quark and gluon jets in gamma - jet events and subsequently the study of the probability of fragmentation in proton, kaon and pion or triggering on jets in the EMCAL. Such a detector would be identify pions until 14 GeV/c kaons from 9 till 14 GeV/c and protons from 18 till 24 GeV/c in a positive way. Additionally identification of protons by absence of signal is possible from 9-18 GeV/c.

11:54AM CF.00008 Nose-Cone Calorimeter: upgrade of PHENIX detector , ONDRJ CHVALA, UC Riverside — PHENIX experiment at RHIC is efficient at measuring processes involving rare probes, but has limited acceptance in azimuth and pseudorapidity (η). The Nose Cone Calorimeter (NCC), a W-Si sampling calorimeter in the region of 0.9< η <3, is one of the upgrades which will dramatically increase coverage in azimuth and pseudorapidity. The NCC will expand PHENIX’s precision measurements of electromagnetic probes in η, reconstruct jets, and enhance triggering capabilities. It will significantly contribute to measurements of γ-jets, quarkonia, and low-m energy nuclear structure functions. Details of the detector design, performance, and a sample of the physics topics which will benefit from the NCC, will be discussed.

12:06PM CF.00009 Measurements of Direct Photon Double Longitudinal Spin Asymmetry at Large Rapiditiy , PAUL BOURJEOPIS, Amherst College, PHENIX COLLABORATION — Direct photon production in polarized p-p collisions is expected to be the cleanest measurement of the gluon polarization. Current measurements using inclusive pion production, in the PHENIX central arms, suggest a small contribution from the gluons to the proton spin in the presently accessible Bjorken x range xBj > 10^-2. The addition of the Nose Cone Calorimeter (NCC) in the large rapidity 1 < η < 3 will allow PHENIX to access xBj ~ 10^-3. In this talk I will present the prospects of measuring direct photon double longitudinal spin asymmetry A_{LL} employing the NCC.

12:18PM CF.00010 Performance and Monitoring of Zero Degree Calorimeter at CMS , HEIDI LESAGE, University of Kansas, ZERO DEGREE CALORIMETER OF CMS AT CERN TEAM — The CMS Zero Degree Calorimeter is designed to measure photons and neutrons for pp and PbPb collisions at TeV energies. The detector can be used for physics and for measuring the brightness and luminosity of the beams. This poster will show the performance of the calorimeter in test beams and describe the monitoring systems we have developed to ensure that the calorimeter is working correctly.
10:30AM CG.00001 A New Approach to Effective Field Theory for Few-Nucleon Physics, DAVID KAPLAN, Institute for Nuclear Theory, SILAS BEANE, University of New Hampshire, ALEKSI VUORINEN, CERN — I describe an alternate formulation of the effective field theory expansion for nucleon-nucleon interactions, which is a hybrid between the approach of Weinberg and that of Kaplan, Savage and Wise (KSW). Like the KSW approach, pion exchange is treated perturbatively, and amplitudes may be computed analytically, yet without the convergence problems previously caused by the tensor force.

10:42AM CG.00002 Bayesian parameter estimation in effective field theories, MATTHIAS R. SCHINDLER, DANIEL R. PHILLIPS, Ohio University — Estimation of low-energy constants (LECs) is an important component of the effective field theory (EFT) program for low-energy QCD. So far the calculation of LECs from QCD is only possible in very few cases, and in practice the LECs are determined by fits to experimental data. There are several questions that need to be considered regarding such a fit: How does one incorporate the information that the LECs are of natural size? At which order in the EFT expansion should the fit be performed? And which data should be used to determine the LECs? We propose a method to address these questions that is based on Bayesian probability theory. The Bayesian framework allows us to incorporate the naturalness assumption by use of a prior probability density. Our method also accounts for the uncertainty due to the vagueness in the definition of “naturalness”. In addition, the choice of the order of the EFT calculation is addressed by marginalization over the order, again systematically accounting for uncertainties. To demonstrate our method we present the application to a “toy” problem as well as a problem in chiral perturbation theory.

10:54AM CG.00003 Cross Sections for $\gamma p \rightarrow p\eta$ and $\gamma p \rightarrow p\eta'$ using data from CLAS at Jefferson Lab., MIKE WILLIAMS, Carnegie Mellon University, CLAS COLLABORATION — Studying $\eta$ and $\eta'$ photoproduction presents a good opportunity to search for missing $N^*$ states, since both mesons act as isoscalar filters. Previous searches for these states in $\gamma p \rightarrow pp\eta'$ have been hindered by limited statistics in the available experimental data. I will present differential cross sections obtained from the CLAS g11a dataset. Measurements have been made in $\cos\theta_{CM}$ bins of width 0.1 for $\eta$ photoproduction in 64 $\sqrt{s}$ bins over the energy range 1.68 GeV < $\sqrt{s}$ < 2.84 GeV and for $\eta'$ photoproduction in 40 $\sqrt{s}$ bins over the energy range 1.92 GeV < $\sqrt{s}$ < 2.84 GeV. The width of the center-of-mass energy bins is from 10 MeV–50 MeV, depending on $\sqrt{s}$. In total, 1082 $\eta$ and 682 $\eta'$ cross section points are reported. These results represent a tremendous increase in the precision of the world’s $\eta'$ photoproduction data and extend the energy coverage by $\sim$ 500 MeV in $\sqrt{s}$.

11:06AM CG.00004 Chiral symmetry restoration and deconfinement in Coulomb Gauge QCD, PENG GUO, ADAM SZCZEPENAI K, Nuclear Theory Center and Physics Department, Indiana University, Bloomington, IN 47405 — Phenomenology of QGP has attracted a lot of attention in recent years. In the framework of Coulomb Gauge QCD we explore dynamical spontaneously breaking of chiral symmetry of QCD vacuum and confinement. In the extension of quasi-quark model at finite temperature and density, we investigate the relation of chiral symmetry restoration and deconfinement as a function of temperature and density. We will show how the confinement potential behaves depending on screening effects once the QCD vacuum and confinement. In the extension of quasi-quark model at finite temperature and density, we investigate the relation of chiral symmetry restoration and deconfinement as a function of temperature and density. We will show how the confinement potential behaves depending on screening effects once the QCD vacuum and confinement.

11:18AM CG.00005 Generalized Sum Rules of the Nucleon, MIKHAIL GORSHTEYN, ADAM SZCZEPENAI K, Indiana University — We consider doubly virtual Compton scattering (VVCS) off the nucleon with the photon virtualities $q_1^2 = q_2^2 = -Q^2$ and formulate the low energy theorem (LET) for this process. We show that the LET can only be defined at finite momentum transfer $t = -2Q^2$ which is at variance with existing studies in the literature. Combining LET with dispersion relations for the forward VVCS amplitude, we obtain the new, correct version of the generalized sum rules of the nucleon that state a correspondence between the low energy constants of VVCS and the moments of the DIS structure functions. We notice that the $t$-channel unitarity is necessary to translate the forward dispersion relations to the low energy limit. This approach leads to a substantial modification of the generalized GDH sum rule at finite $Q^2$ that undergoes extensive studies at JLab. For the spin-independent VVCS amplitude, the new sum rule for the generalized magnetic susceptibility $\beta(Q^2)$ is obtained. Our approach provides a consistent, Lorentz invariant formulation of LET for the most general VVCS process that removes inconsistencies that stain the previous studies of the generalized polarizabilities of virtual Compton scattering and the generalized sum rules of the nucleon.

11:30AM CG.00006 ABSTRACT WITHDRAWN

11:42AM CG.00007 N to Delta Transitions from QCD Sum Rules, LAI WANG, FRANK LEE, George Washington University — We present a calculation of the $N$ to $\Delta$ electromagnetic transition amplitudes from the method of QCD Sum Rules. A complete set of QCD sum rules is derived using the external field method and generalized interpolating fields for the entire family of transitions from baryon octet to decuplet. For each transition, thirteen sum rules are constructed from thirteen independent tensor structures. They are analyzed by a Monte-carlo procedure. Valid sum rules are identified from which the magnetic dipole $G_{M1}$ and the electric quadrupole $G_{E2}$ are determined. The results are compared with calculations from other models and experiment from JLab and other accelerators.

11:54AM CG.00008 Precision Measurement of $\pi^0$ Electroproduction Cross Section Near Threshold, MITRA SHABESTARI, University of Virginia, JEFFERSON LAB $\pi^0$ COLLABORATION — A high precision measurement of the reaction $H(e,e'p)\pi^0$ was performed near threshold (experiment E04-007) at Jefferson Laboratory. Measurements were made in a fine grid of $Q^2$, in the range $0.045$ (GeV/c$^2$)$^2 \leq Q^2 \leq 0.15$ (GeV/c$^2$)$^2$, and $\Delta W$ in the range $0$ MeV $\leq \Delta W \leq 30$ MeV. The data were taken in Hall A. Polarized electron beams at energies of 1194 and 2232 MeV were used to bombard a liquid hydrogen target. The target was contained in a new and very small aluminum cell with a thin beam entrance window, and thin side walls to minimize the energy loss of low-energy protons recoiling out of the target. The pion was identified by detecting the electron in one of the high-resolution spectrometers in coincidence with the recoiled proton, in the large acceptance “BigBite” spectrometer. These coincidence data allow us to test chiral QCD dynamics: a test which has become more critical as earlier measurements showed disagreement with the predictions of chiral perturbation theory. The experimental details will be discussed, and progress in data analysis will be presented.
2:06PM CG.00009 Electroproduction of soft pions at high $Q^2$ near the threshold from CLAS

KLIUN PARK, RALF GOTHE, University of South Carolina, PAUL STOLER, RPI, CLAS COLLABORATION — Threshold pion electroproduction has long been a topic of interest for both experimental and theoretical studies. In chiral symmetry, the approximately zero pion mass allows one to make exact predictions for threshold cross sections using low energy theorems (LET). The LET established the connection between charged pion electroproduction and the axial form factor in the nucleon. Thanks to the inclusive electroproduction process $e^+e^-\rightarrow n\pi^+$, [KPark08] which was measured in the interval of $Q^2$ from 2.0 to 4.5 GeV², an invariant mass range in the $n\pi^+$ system from $W = 1.11$ to 1.15 GeV. The CEBAF Large Acceptance Spectrometer (CLAS) was used to carry out these measurements.

2:00PM - 2:00PM
Session DA CEU Poster Session (14:00 - 15:48) Lobby

DA.00001 E906 Experiment: Study of Background Rates with a Solid Magnet, OBIAGELI AKINBULE, Abilene Christian University, E906 FERMILAB COLLABORATION — Fermilab (Fermi National Accelerator Laboratory) E906 is an experiment to determine the ratio of d-bar to u-bar quarks in the nucleon sea. The experiment measures the di-muon pairs that are produced via the Drell-Yan process, which is when a quark and anti-quark annihilate, creating a di-lepton pair. With a goal of extending the E866/NuSea measurements to higher Bjorken x, it will help reveal the structure of the proton. The results to be presented focus on using GEANT4 Monte Carlo simulations to investigate spectrometer acceptance and background rates if a solid iron magnet is used, as opposed to the original plan of an open magnet filled with hadron absorbers. A solid iron magnet would be relatively low cost, since the coils and iron can be taken from parts of the E866/NuSea detector apparatus. Results of these simulations will be shown to demonstrate that the solid iron magnet will give acceptable results. Results will also be shown on ideas to reduce the background from in-flight pion decays from the liquid hydrogen and deuterium targets.

DA.00002 Developing an Efficient Read-Out System for the A2 Pair Spectrometer at Mainz¹, AMAL AL KATRIB, WILLIAM BRISCOE, George Washington University, MAÎNZ MICROTON A2 COLLABORATION — The scientific program at the Mainz Micron (MAMI) is based on polarized electron and photon beams from the MAMI A-B-C accelerator complex. The scientific program at the Mainz Micron (MAMI) is based on polarized electron and photon beams from the MAMI A-B-C accelerator complex with energies up to 1.5GeV. In order to deal with the energy increase, the photon target system has been extended and refurbished by the Glasgow University Nuclear Physics Group. It is now available for real photon experiments in the A2 hall. For experiments with real photons in the A2 hall, the Crystal Ball detector is being used regularly together with an inner detector for tracking and a forward crystal calorimeter (TAPS) for 4pi gamma coverage. A new data acquisition system with high-rate performance is in operation. Experiments are currently running using a liquid hydrogen/deuterium target. The Pair Spectrometer in the A2 hall is not providing timing information efficiently due to the various disadvantages of using photomultiplier tubes in high magnetic fields. This poster will include the current status of the experimental development effort, the scientific program at MAMI, Student will discuss the project given in hand, which is replacing photomultipliers in the Pair Spectrometer with avalanche photodiodes that are not affected by the 1 Tesla magnetic field. The output of 2 detectors, a large area avalanche photodiode and a multi-pixel photon counter, is observed and compared for better rise time and detection of electron-position pair as the photon beam hits matter. For testing purposes, the photodiode is attached to a scintillator and is connected to a pre-amplifier (ORTEC 474) followed by a timing amplifier (ORTEC 474) and then a pulse shape discriminator (model 2160A).


DA.00003 Metal Oxide Films Produced by Polymer-Assisted Deposition (PAD) for Nuclear Science Applications, MAZHAR ALI, MITCH GARCIA, NOEL CHANG, TASHI PARSONS-MOSS, JACKLYN GATES, UC Berkeley, PAUL ASHBY, LIV STAVSETRA, KENNETH GREGORICH, Lawrence Berkeley National Lab, HEINO NITSCHKE, UC Berkeley — The preparation of homogenous metal oxide films (100 to 750 nm) is of interest to nuclear science for use as targets in nuclear reactions. Metal oxide targets, prepared for nuclear science applications, are the conventional in Mainz and the role of student involvement in the program at MAMI. Student will discuss the project given in hand, which is in operation. Experiments are currently running using a liquid hydrogen/deuterium target. The Pair Spectrometer in the A2 hall is not providing timing information due to the various disadvantages of using photomultiplier tubes in high magnetic fields. This poster will include the current status of the experimental development effort, the scientific program at MAMI. Student will discuss the project given in hand, which is replacing photomultipliers in the Pair Spectrometer with avalanche photodiodes that are not affected by the 1 Tesla magnetic field. The output of 2 detectors, a large area avalanche photodiode and a multi-pixel photon counter, is observed and compared for better rise time and detection of electron-position pair as the photon beam hits matter. For testing purposes, the photodiode is attached to a scintillator and is connected to a pre-amplifier (ORTEC 474) followed by a timing amplifier (ORTEC 474) and then a pulse shape discriminator (model 2160A).

DA.00004 Searching for a Betatron Tune Working Point for the Proposed Electron-Ion Collider at Jefferson Laboratory, SCOTT ALTON, MSU/ODU/Lab, REU AT ODU TEAM — The mechanics of relativistic particles in storage rings are well understood. The particles oscillate around the intended orbit in the transverse X and Y directions—called the betatron oscillations. The number of oscillations per orbit is known as the betatron tune. If the betatron tune is an integer or a special resonance value, the oscillations will build in amplitude due to constructive interference and the beam will become less focused. This becomes complicated in the proposed E-Lectron-Ion Collider at Thomas Jefferson National Accelerator Facility (ELC). The ELC will be similar to a storage ring except that there will be beams of particles in both directions through each other several times every turn around the ring. When the beams pass through one another, they give each other a “kick” which alters the betatron tune often causing it to become one of the resonance values and degrading the beam quality and luminosity, which is a measure of the number of collisions per turn around the ring. The betatron oscillations will narrow down the range of betatron tunes that are available to operate the collider with a well focused beam. The purpose of this research was to find a betatron tune working point, or a set of betatron tunes in both transverse directions, which optimize the luminosity for both beams. A tune map shows which areas of the tune map are far from the regions of resonance. The region that was used was near half integer, because there was a large space on the tune map that was far from the regions of resonance. Simulations were run that broke down the collider rings into a series of line maps around the ring and elementary forces at the point where the two beams interact. The goal was to find a betatron tune point where the beams stayed focused after many turns. An effort was made to separate the different tunes to find out how each one affected the luminosity but due to the highly nonlinear nature of the forces involved, this was ineffective. A stable working point has been found in the half integer region of the tune map. The point maintained about 65% of its peak luminosity after 30000 turns. This compares well with some of the best working points that have been found which top out at around 70% of the peak luminosity. It was found that there are certainly stable working points in the half integer region, and more points should be explored in this promising region of values. With a good working point, it will be possible to build a high luminosity collider allowing new experiments involving quantum chromo dynamics.
DA.00005 Signal Readouts in a PHENIX RPC. Keller Andrews, PHENIX Collaboration — The PHENIX collaboration at RHIC studies polarized proton-proton and heavy ion collisions to better understand the structure of the proton. PHENIX is in the process of upgrading the muon trigger to improve their capabilities of studying the production of W-bosons. By triggering on single, high transverse momentum muons among a background of low transverse momentum muons, new observations on the inner structure of a proton can be obtained. The trigger upgrade will consist of six stations of Resistive Plate Chambers (RPCs), three stations on each side of the interaction region. Inside an RPC, there are several copper strips, called a signal plane. When a charge is induced on them by a charged particle (a muon) traveling through an adjacent gas gap, it passes a charge from the strip, into a readout wire. The wire runs to a card that translates the signals from the signal plane to the readout electronics (a transition card). In the readout electronics, the signal is amplified and sent to a discriminator that produces a digital record of the charged particle’s path. This poster will explain how RPCs work and how the signal is generated in the prototype PHENIX detectors.

DA.00006 The High Voltage System for the PHENIX RPC Test Stand, Phil Bailey, Abilene Christian University — PHENIX is an experiment at RHIC designed to study the spin structure of the proton by observing high energy polarized proton-proton scattering. Observing W boson production is an effective way to make this measurement. The W bosons are identified by detecting their decay into muons. In order for these rare events to be effectively measured, however, the muon trigger requires an upgrade that will allow the higher rejection rate required by higher luminosity data to be achieved. However, for this upgrade to be effective, it must be tested in order to make sure that it can function properly. In order to test the working condition of the RPCs, they will be placed on a test stand in order to gain assurance that cosmic muons are seen by the detectors. The high voltage systems, including cabling and data logging software, that operate the RPCs in the cosmic test stand will be presented.

DA.00007 Evidence for Multiple Negative-Parity Band Structure in 71Se1, N.R. Baker, R.A. Kaye, S.R. Arora, Ohio Wesleyan University, J.K. Bruckman, Monmouth College, S.L. Tabor, T.A. Hinnners, C.R. Hoffmans, S. Lee, Florida State University, J. Doring, BFS (Germany) — The negative-parity bands of 70Se and 72Se indicate a stark contrast between strong single-particle (64Se) and collective (73Se) behavior over a wide range of spins. However, only one negative-parity band has been observed so far in 71Se, making it difficult to see where it lies between these two very different cases. Thus, the goal of the present work was to extend the level scheme of 71Se as much as possible, with an emphasis on finding new negative-parity states. 71Se nuclei were produced at high spin following the 80-MeV 34Fe (21Na, αpn) reaction at Florida State University. γ − γ coincidences were measured using an array of 10 Compton-suppressed Ge detectors which included three Clover detectors. From the coincidence relationships, new states were found that formed candidates for perhaps two new negative-parity bands. Cranked-shell model calculations indicate that one new band is associated with rigid-body rotation at high spin.

DA.00008 Forward RPC Trigger Design and Integration at PHENIX, Austin Basye, Abilene Christian University — PHENIX is a general-purpose particle physics experiment at the Relativistic Heavy Ion Collider (RHIC) studying polarized proton and heavy ion collisions. One of PHENIX’s goals is to define the sea quark contribution to proton spin by using W boson asymmetries arising from quark-antiquark interactions in polarized proton collisions. This analysis is dependent on the reconstruction of single, high transverse momentum (pT) muons. The Forward Resistive Plate Chamber (RPC) Upgrade will allow PHENIX’s muon arms to trigger on probable W boson events despite a significant low pT muon background. To that end, the RPC design team was tasked with designing and installing four stations of detectors (each ~80 m2 in surface area) into the existing PHENIX architecture. This poster will discuss our approach to balance cost, practicality and complexity on the one hand with efficiency, resolution and acceptance on the other hand using RPC detector technology.

DA.00009 Gamma Ray Spectroscopy of Heavy Elements using GAMMASPHERE1, Marco Bonett-Matiz, UMass Lowell — The project involves data analysis to study excitations in heavy nuclei in and around the nucleus 209Bi. The data is from an experiment that was carried out to study heavy nuclei in the 248Cm region. The experiment consisted of a 209Bi beam from the ATLAS heavy-ion accelerator at Argonne National Laboratory incident on a 248Cm target. The beam energy was 1450 MeV, ~15% above the Coulomb barrier. Excited states in both target-like and beam-like nuclei were populated. While the primary focus of the experiment was to study isomers in 248Cm, this complementary project was to study excitations of 209Bi and neighboring nuclei around the doubly magic 208Pb. The gamma rays were detected by the GAMMASPHERE array of 100 germanium detectors. Level schemes were analyzed through gamma matrices and cubes using the standard RADWARE suite of programs. Angular correlations were analyzed for multipolarity information. Isomer halflives in the nanosecond to microsecond range were studied. New isomers in 209Bi, expected on the coupling of an extra proton to the 208Pb core, were searched for. Results of the above spectroscopic studies will be presented.

1 DOE Department Of Energy

DA.00010 Electron Identification for Jet Finding Algorithms in ALICE, Brandon Boswell, Christopher Brown, J.L. Klay, California Polytechnic State University, San Luis Obispo, ALICE Collaboration — Particle jets emitted by heavy ion collisions in the ALICE experiment at the LHC can be measured with jet-finding algorithms that have been adapted to account for the large heavy ion backgrounds. Jet-finding algorithms are based on the reconstruction of single, high transverse momentum (pT) muons. The Forward Resistive Plate Chamber (RPC) Upgrade will allow PHENIX’s muon arms to trigger on probable W boson events despite a significant low pT muon background. To that end, the RPC design team was tasked with designing and installing four stations of detectors (each ~80 m2 in surface area) into the existing PHENIX architecture. This poster will discuss our approach to balance cost, practicality and complexity on the one hand with efficiency, resolution and acceptance on the other hand using RPC detector technology.

DA.00011 Greta Pile-Up Recovery1, Whitney Brooks — The proposed Gamma Ray Energy Tracking Array uses Ge detectors to track interactions by each gamma ray detected. Tracking determines which interactions belong to which gamma rays using the energy and position of the interaction found properties of Compton scattering. Detectors are connected to a pre-amplifier which puts out a pulse signal when a gamma ray is detected. The pre-amplifier is connected to a Digital Signal Processor which digitizes the pulse shape using a 10 ns sampling time, showing an image of the pulse. The rise time for the signal is 100-200 ns. The signal decays with a time constant of about 50 microseconds. The height of the pulse is proportional to the energy of the gamma ray. Sometimes a second gamma ray is detected before the pulse signal of the first one has fully decayed, creating a pile-up of pulse signals. LBNL’s current data analysis system performs “Pile-Up Rejection” where it discards any data not deemed a single pulse. My code performs Pile-Up Recovery, enabling us to get more data instead of rejecting useful data. The code uses derivatives and regression lines to tell if a pulse is a single pulse or a pile-up pulse. If a pile-up is detected, the two are separated and the energy of each is found.

1 Summer Research - University of Richmond
DA.00012 Performance of the STAR Heavy Flavor Silicon Tracker in Measuring the Charged B Meson through $B \rightarrow J/\Psi + X$ Decay, ELIZABETH BROST, Grinnell College / Purdue University REU program — The STAR detector, located at the Relativistic Heavy Ion Collider at Brookhaven National Laboratory, gathers data from particle collisions. STAR’s main task is to study the properties of the matter produced in these collisions, particularly the quark-gluon plasma (QGP), which is expected to have been created a few microseconds after the “Big Bang”. Among all probes used to study the properties of the QGP, heavy quarks are unique, and ideal for studying the QGP because of their large mass. One particularly interesting way to study heavy quarks is through the $B \rightarrow (J/\Psi \rightarrow e^+e^-) + X$ decay channel, since there is very little background. Using simulated central Au+Au collision data containing electron-positron pairs from $B \rightarrow J/\Psi$ decay and from prompt $J/\Psi$ decay, I was able to reconstruct the displaced vertices ($L_{xy}$) for the $J/\Psi$ particles. Then, I made a distribution of $L_{xy}$ for $B$ decay (signal) and prompt (background) $J/\Psi$ particles. Finally, after making successive cuts of $L_{xy}$, I created signal-to-background and efficiency distributions for measuring the charged B mesons in central Au+Au collisions through this decay channel.

DA.00013 Study of Carbon 16 Within the Three-Body Model, H.J. BROWN, Florida State University, F.M. NUNES, Michigan State University — In this study the Carbon 16 nucleus has been examined within a three-body model Carbon 14 + n + n. The valence neutrons interact with a realistic n-n force while the Carbon 14 - neutron interaction was fit to reproduce the low-lying single particle spectrum of Carbon 15. Two shell model pictures of Carbon 15 were considered, each differing in the treatment of the p-wave orbitals. The main results presented assume the Carbon 14 core is inert but we also will mention preliminary results including core deformation and excitation. Our findings indicate that in order to build a more realistic Carbon 16, we must account for the inversion of the p + s wave resonances in Carbon 15. Our model is in fair agreement with experimental values for the Carbon 16 ground state three-body binding energy and RMS radius. This calculation predicts the lowest 0.0+ and 2.0+ states in Carbon 16 with the proper ordering but excitation energies are a bit smaller than experiment.

DA.00014 Assembly and Quality Assurance Tests of Gas Gaps for the PHENIX Muon Trigger Upgrade, DAVID BROXMEYER, Muhlenberg College, PHENIX COLLABORATION — The RHIC “spin” program investigates the spin of a proton by looking at collisions between polarized protons. W bosons are sometimes created in these collisions. The parity violating decay of W bosons can be used to identify the underlying quark-quark and quark-antiquark interaction. The PHENIX muon trigger upgrade will utilize resistive plate chambers (RPCs) to distinguish the muons that decay from W bosons from other muons. The RPCs use 95% Freon 134A, 4.5% isobutene, and 0.5% sulfur hexafluoride (SF6). In order for these gas gaps to be used, checks are performed on the gaps. The gas gaps must contain no leaks. Approximately 10kV are placed across the 2mm gaps and therefore the gaps require spacers to insure that there is uniform separation between the surfaces. Popped spacer tests are performed to insure that the spacers are properly attached.

DA.00015 Evolution of Collective Structure in Odd-Odd $^{70}$As, J.K. BRUCKMAN, Monmouth College, R.A. KAYE, S.R. ARORA, N.R. BAKER, Ohio Wesleyan University, S.L. TABOR, T.A. HINNERS, C.R. HOFFMAN, S. LEE, Florida State University, J. DOERING, Bundesamt fuer Strahlenenschutz, Germany — Excited states in $^{70}$As were produced via the $^{23}$Na($^{4}$Fe, $\alpha 2p\gamma$) reaction at 80MeV. Gamma-ray transitions between the excited states were collected in coincidence using a high-resolution array of 10 Ge detectors. From the coincidence relationships, a candidate for the missing odd-spin negative-parity sequence was found, with spins and parities assigned tentatively using systematic arguments. All other high-spin level sequences found were confirmed. Fourteen new high-spin states were confirmed. The known moments of inertia for the new band and those observed previously, calculated within the context of the cranked-shell model, show that $^{70}$As is likely dominated by collective behavior at high spin, making it more similar in this regard to $^{72}$As than to $^{68}$As. Collectivity and deformation also seem to increase with neutron number in the light proton-rich arsenic isotopes.

DA.00016 Design and Construction of a Drift Chamber for RPC Detector Development, ALEX BURNAP, University of Illinois Urban-Champaign, PHENIX COLLABORATION — Currently, the PHENIX experiment at the Relativistic Heavy Ion Collider at Brookhaven National Lab is developing resistive plate counters (RPCs) to be used as one component of the Level 1 trigger for high pT muons produced in the decay of W-bosons. The single spin asymmetries of W-bosons in polarized p-p collisions can be used to measure sea quark spin contributions to the proton spin. RPC prototypes are tested at UIUC by utilizing cosmic rays. Drift chambers are placed in planes parallel with resistive plate counters for cosmic ray track reconstruction. The drift chamber design was updated with novel improvements, optimized using Garfield simulation, and a prototype was built and tested. In this poster we present results from the simulation, details of the design and construction, as well as test results obtained from the drift chamber kaon.

DA.00017 Parton Distributions of the Kaon and the Tetraquark, BONNIE CANION, Seattle University — The goal of this research is to describe parton distributions for the $K^+$ meson (kaon) and the tetraquark. We used the statistical model of Zhang et al. [1,2], which describes a particle as an expansion in quark-gluon Fock states, assumes detailed balance, and does not use any free parameters. The $K^+$ meson and tetraquark are each made up of a set number of valence quarks, and a sea of light quark-antiquark pairs and gluons. The $K^+$ meson has two valence quarks, $u$ and $\bar{d}$. The tetraquark, an exotic meson recently discovered [3] by the Belle collaboration at KEKB, is composed of four valence quarks, $u$, $d$, $c$, and $\bar{c}$. To find the parton seas for these particles, three processes were considered, $g \rightarrow qq$, $g \rightarrow q\bar{q}$, and $g \rightarrow gg$. Similar to the proton, there is an asymmetry in the parton sea of the $K^+$ meson, which was found to be $\bar{d} - u = 0.26(4)$. The tetraquark light quark sea was found to be symmetric. These mesons are further described by their parton momentum distributions, which were determined by using a Monte Carlo code. Understanding the parton distributions of particles is increasingly important as we approach the opening of the LHC. This research has been supported in part by the Research in Undergraduate Institutions Program of the National Science Foundation, Grant no. 0555706. References [1] Y.-J. Zhang et al, Phys. Lett. B 523 (2001) 260. [2] Y.-J. Zhang et al, Phys. Lett. B 528 (2002) 228. [3] S.-K. Choi et al. (Belle collaboration), Phys. Rev. Lett. 100 (2008) 142001.

DA.00018 Position determination of fragile objects in nuclear physics experiments, HOI KIT CHEUNG, The Chinese University of Hong Kong; UC Berkeley, M. BETTY TSANG, NSCL, MSU, Michigan — To study the single particle nature of unstable nuclei, inverse kinematics with radioactive beams in transfer reactions have to be used. In such experiments, it is important to determine the exact positions of the beam and detected particles. A Laser Based Alignment System (LBAS) has been successfully used in several nuclear physics experiments. LBAS is designed to determine positions of sharp edges with sub-millimeter accuracy without physical contact with the measured object. In the recent p($^{34}$Ar,d) transfer experiments, the beam positions at the target are reconstructed with Channel Plate Detectors, the emitted deuterons are detected with the High Resolution Array (HIRA) and the recoil particles are measured with the $^{88}$O spectrometer. The HIRA device consists of multiple telescopes, each of which consists of 1024 pixels, with the dimension of 1.95x1.95mm$^2$ for each pixel. We use LBAS to determine the positions of the target, the channel plate detectors, and the pixels positions of HIRA. We then map these elements to the global positions of the $^{88}$O spectrometer and its magnetic elements.

1 This work is supported by the National Science Foundation under Grant Nos. PHY-0606007 and SURE.
DA.00019 Developing a computer code simulating recoil-beta decay tagging of fission products, BERTA DARAKchieva, University of Richmond — Neutron-rich nuclei far from stability exhibit insightful structural patterns and deformations, and can be used for testing existing nuclear theories. However, experimental information on many such nuclei is lacking, because they are hard to produce directly or through fusion-evaporation reactions. One way to population such neutron-rich nuclei is by exploiting the fission process. Since these nuclei are primarily beta emitters, a technique of recoil beta tagging can be employed. A gas-filled separator, such as SASSYER (WNSL) or BGS (LSNL), can be used to select a mass window of fission fragments, which will be implanted on a DSSD detector located at the focal plane of the separator. By selecting high beta-endpoint energies, characteristic for the nuclei of interest, decays at the DSSD can be correlated to emitted gamma rays for further spectroscopy studies. An essential step in planning this project would be the development of a computer simulation of count rates at the DSSD. The program works by reading in files of half-lives and fission yields and uses a step-by-step iteration process. The role of the code is two-fold: to help identify a suitable nucleus for study and to optimize a mass window for its highest count rate. To test the method, experiments are planned with a fission source, such as Cf-252, placed at the target position of a recoil separator. If successful, the technique could be extended to in-beam experiments.

DA.00020 Optimization of a Drift Chamber for Cosmic Ray Tracking Using Garfield Simulations, GEORGE DEINLEIN, PHENIX - University of Illinois at Urbana-Champaign — The PHENIX experiment at the Relativistic Heavy Ion Collider at Brookhaven National Laboratory seeks a precise measurement of the spin contribution from sea quarks to the proton spin. This is accomplished by measuring the asymmetry in W-boson production in longitudinally polarized proton-proton collisions, where W-decays are signaled through the presence of high transverse momentum muons. The first level trigger in the detection of these muons will employ resistive plate counters (RPCs). As part of the research and development of these RPCs, at UIUC, drift chambers assist with cosmic ray tracking. Improvements have been made to the current drift chamber design, and are being implemented and tested in PHENIX’s cosmic ray test stand. In this poster, specific improvements will be discussed, as well as the design process, which involved detailed Garfield simulations.

DA.00021 Experimental system to search for induced depletion of $^{166}\text{Ho}$, BEN DETWILER, SHANE DOWNING, NATHAN CALDWELL, JAMES CARROLL, Youngstown State University, NINO PEREIRA, Ecopulse, Inc., MARC LITZ, GEORGE MERKEL, Army Research Lab, JOE SCHUMER, Naval Research Lab — Known nuclear data indicate that incoming photons below 300 keV might cause an induced depletion of the 1200 year isomer of $^{166}\text{Ho}$. This process would be identified by an excess of ground state activity after irradiation with bremsstrahlung or by excess activity in any excited state that was part of the depletion cascade. A unique sign of depletion in $^{166}\text{Ho}$ would be radiation emitted near 136 keV from a level above the isomer, but part of the expected depletion cascade. A detection system has been developed using a gated fast inorganic scintillator to observe gamma rays after pulsed irradiation of an isomeric sample containing $^{166}\text{Ho}$ using an electron linac.

DA.00022 Determination of the $^{11}\text{B}(\alpha,\alpha)^{11}\text{B}$ Cross Section below 7 MeV, CHELSEY DRIESSEN, University of Wisconsin Stevens Point, M.W. AHMED, S.S. HENSHAW, B.A. PERDUHE, P.-N. SEO, S. STAVE, H.R. WELLER, TUNL, R.M. PRIOR, M.C. SPRAKER, North Georgia College and State University, P. MARTEL, A. TEYMUZRAZYN, U. Mass., R.H. FRANCE, E. SAND, A. SMITH, Georgia College and State University — The use of $^{11}\text{B}$ as a fusion energy resource using the $^{11}\text{B}(p,\alpha)^{11}\text{B}$ reaction has been studied for over 50 years. Recently TUNL has been requested to investigate discrepancies in previous measurements of the cross section of $^{11}\text{B}(\alpha,\alpha)$. The cross sections were measured using silicon surface barrier detectors at 45, 60, 75, 90, 90, 110, 130, 150 degrees. The target used for the measurement of the cross section of $^{11}\text{B}$ was composed of 2-3 $\mu$g/cm$^2$ of pure $^{11}\text{B}$ with two surrounding thicker layers of gold. The alpha source and the tandem accelerator at TUNL were used to create a beam with a maximum energy of 7 MeV. Preliminary cross sections as a function of energy and angle will be reported and compared to previous results.

DA.00023 Structural investigation of the nuclei in $Z=52$ to $Z=78$ region by E-GOS method, KELSEY DUDZIAK, D.A. MEYER, Rhodes College — The E-GOS (E-Gamma Over Spin) method allows us to empirically determine the structure of a nucleus as a function of its angular momentum through a comparison to the ideal limits of perfect harmonic vibrator and axially symmetric rotor. Unique to the E-GOS method, no preconceived notion of nuclear structure is necessary. It differs from other common models by analyzing structural evolution as a function of angular momentum rather than as a function of nucleon number. In this project, we applied E-GOS method to the yrast bands of nuclei in the region $Z=52$ to $Z=78$ by mapping the E-GOS curves in this manner shows a clear transition from vibrational to rotational motion.

DA.00024 Spatial Reconstruction of Co-60 Radiation Sources Using Goodness-of-Fit Tests on Spectra Obtained from an HPGe Detector, LENNY EVANS, University of North Carolina at Chapel Hill — The effect of the position of a Co-60 point source on the shape of spectra was observed in both Monte Carlo and HPGe detector measurements. HPGe detectors are used in numerous low background assay systems and this spatial reconstruction could be used to locate unwanted backgrounds. Spectra taken with the radiation source placed at points on the face and side of the detector were compared in peak areas and were compared using the Kolmogorov-Smirnov goodness-of-fit test. We will discuss the position reconstruction accuracy of this statistical method.

DA.00025 Calibration of the Shower Maximum Detector in the Barrel EMC at STAR, KARA FARNSWORTH, SASKIA MIODUSZEWSKI, MARTIN CODRINGTON — The STAR detector at RHIC was designed to measure properties of the quark-gluon plasma (QGP), a deconfined medium of quarks and gluons produced in high-energy heavy-ion collisions. The measurement of $\gamma$-jet (in which a direct photon is produced back-to-back with a jet) is a particularly good probe of the density of the produced medium. However background photons, like those from $n^0$ decays, can contribute to the selection of high-energy direct photon trigger particles. To distinguish between direct and decay photons, the shower profile in the Barrel Shower Maximum Detector (BMD) of the Barrel Electromagnetic Calorimeter (BEMC) is analyzed. The BMD has very good spatial resolution ($\Delta R$ < 0.007), and a refined calibration promises to improve its performance in $\gamma$/hadron discrimination. A summary of the quality assurance and calibration performed on the BMD strips will be presented.

DA.00026 The Joint Institute of Nuclear Astrophysics Virtual Journal, RYAN FERGUSON, National Superconducting Cyclotron Laboratory / Michigan State University — We have developed a weekly, online system for collecting and distributing scholarly articles of interest to researchers in nuclear astrophysics, a virtual journal (VJ), through the Joint Institute of Nuclear Astrophysics (JINA). The articles are gathered from a variety of well-known publications, and our database of both current and past issues is easily searchable by topics, chosen by the editors, or by keywords. Subscribers are notified of each new VJ issue through an email-list server. The VJ is a source for experimental and theoretical data for the JINA reaction rate database, and the references to review and popular level articles are a convenient way to introduce students to the literature. There are two related journals: the JINA VJ and the SEGUE VJ. Both the journals and support information are available at http://groups.nscl.msu.edu/jina/journals.
DA.00027 Probing 23% of the Universe at the Large Hadron Collider¹, WILL FLANAGAN, University of Colorado, Texas A&M Cyclotron REU, TEXAS A&M HIGH ENERGY PHYSICS TEAM — With recent astronomical measurements, we know that 23% of the Universe is composed of dark matter, whose origin is unknown. Supersymmetry (SUSY), a leading theory in physics, provides us with a cold dark matter candidate, the lightest supersymmetric particle (LSP). SUSY particles, including the LSP, can be created at Large Hadron Collider (LHC) at CERN. We perform a systematic study to characterize the SUSY signals in the “focus point” region, one of a few cosmologically-allowed regions in our SUSY model. We also present a methodology for extracting the dark matter signals at the LHC, and show the accuracy to which we can measure the dark matter relic density and the SUSY parameters.

¹Many thanks to the Texas A&M Cyclotron REU and the Texas A&M HEP Group.

DA.00028 Geant4 Simulation of MoNA², A. FRITSCH, Wabash College, M. HEIM, Marquette University, T. BAUMANN, S. MOSBY, A. SPYROU, Michigan State University, MONA COLLABORATION — The Modular Neutron Array (MoNA) is a neutron detector array consisting of 144 plastic scintillator detector modules at the National Superconducting Cyclotron Laboratory (NSCL). The detailed simulation of the neutron interaction with the detector is a crucial tool for optimizing detector configurations and analyzing experimental data. For this purpose the MoNA collaboration is developing a simulation package based on Geant4, a state-of-the-art C++ toolkit for the simulation of the passage of particles through matter. Our work this past summer involved introducing detector geometry into the Geant4 code, as well as determining how the program handles simulations of different physical interactions inside of the detector. By upgrading from Geant3 to Geant4, we are able to better simulate the physics of our experiments.

²This work was supported by the NSF under grants No. PHY07-54541 and No. PHY05-55445.

DA.00029 Dalitz Plot for $\eta \rightarrow \pi^+ \pi^- \pi^0$, MIGUEL GARCIA, Arizona State University, CLAS COLLABORATION — I present a preliminary Dalitz plot analysis of the decay $\eta \rightarrow \pi^+ \pi^- \pi^0$. The data used in this analysis were taken by the CLAS Collaboration during the g1c running period. A physical interpretation of the Dalitz plot is provided. Extraction of parameters related to the shape of the Dalitz plot is compared to theoretical predictions, as well as previous experimental values. Comparison of the data with these theoretical predictions might shed light on the double-quark mass ratio for the SU(3) constituent quarks. This important subject will be discussed briefly.

¹Work at Arizona State University is supported by U.S. National Foundation.

DA.00030 Investigation of Neutron Scattering in the Modular Neutron Array (MoNA), MICHAEL GARDNER, WARREN F. ROGERS, Westmont College, MONA COLLABORATION — The MoNA Collaboration consists of scientists from several primarily undergraduate institutions and from MSU and FSU that investigate the properties of light neutron-rich nuclei in the vicinity of the neutron drip line. The MoNA array consists of 144 organic scintillator detectors stacked in 9 columns of 16 detectors each, used to determine the energy and trajectory of neutrons resulting from nuclear breakup reactions. When MoNA is used in conjunction with the Sweeper magnet kinematic reconstruction of the breakup is made possible. We are currently developing algorithms to enable MoNA to discriminate neutron multiplicity resulting from breakup. This process is significantly complicated by elastic and inelastic neutron scattering from carbon nuclei in the scintillator, which not only changes the neutron trajectories predominantly below the energy threshold of the detectors, but can also produce additional neutrons. By investigating the relative time and distance between multiplicity-two neutron events occurring in the first two layers of the array, we have been able to obtain slightly different signatures for data sets involving one- and two-neutron decays. Results will be presented.

DA.00031 The Effects of a Late Decaying Scalar on Dark Matter Density, KATHERINE GARRETT, STEPHANIE SCHUK, GINTARAS DUDA, Creighton University — The neutralino as dark matter has yet to be discovered, either through direct detection of its interaction with detectors here on Earth, or through indirect detection of the products of neutralino self-annihilation processes. Dark matter searches have pushed limits of the neutralino’s cross section so far down that only a handful of theoretical models with carefully constrained parameters can fit the experimental data. This seems unnatural; a correct model of neutral dark matter should not have to be finely tuned to serve as a solution. The addition of a late decaying scalar particle, which essentially decays into the Lightest Supersymmetric Partner, has been shown to give neutralino densities in a more natural range needed for dark matter for a wide range of parameter space. We have implemented the addition of the scalar field in the code of DarkSUSY, run models, probed the parameter space, and compared the results of this modification with results from standard cosmological models. We also compared results from the simulations with the bounds set on dark matter from detection experiments; this let us place limits on properties of the scalar field and on non-standard cosmology scenarios.

DA.00032 Bit-Error Ratio Testing of Xilinx FPGAs Using Pseudo-Random Binary Sequences, ANDY GOERS, Iowa State University — With RHIC collision rates reaching orders of a MHz in pp reactions, it is vital that detector electronics are able to process the massive influx of data received every second. Much of this data processing is done by field programmable gate arrays (FPGAs). However, with any experimental setup, one must know the limitations of the apparatus. High speed electronics often see bit errors due to attenuation or simply from hardware failures. Bit errors in detector electronics can show up as bad data and even “fake” particles, so it is important to know how often these bit errors occur. Pseudo-random binary sequences (PRBS) are often used to test high speed electronics’ bit-error ratios (BER), or errant bits per bits received. A PRBS is generated using polynomials creating a seemingly random sequence of binary numbers. A BER can be measured by sending out and receiving a known PRBS and checking for errors in the received sequence. I will present results of BER testing of gigabit transceiver protocols on Xilinx Virtex 5 LXT50T and LXT110T FPGAs for PHENIX detector electronics upgrades.

DA.00033 Measuring Rate Capability of a Bakelite-Trigger RPC Coated with Linseed Oil, LEAH GOLDBERG, Illinois Wesleyan University, PHENIX COLLABORATION — The PHENIX experiment at the Relativistic Heavy Ion Collider at Brookhaven National Laboratory intends to study proton spin structure through the detection of high energy photons. In order to analyze the data, we need to continuously process the massive influx of data received every second. Much of this data processing is done by field programmable gate arrays (FPGAs). However, with any experimental setup, one must know the limitations of the apparatus. High speed electronics often see bit errors due to attenuation or simply from hardware failures. Bit errors in detector electronics can show up as bad data and even “fake” particles, so it is important to know how often these bit errors occur. Pseudo-random binary sequences (PRBS) are often used to test high speed electronics’ bit-error ratios (BER), or errant bits per bits received. A PRBS is generated using polynomials creating a seemingly random sequence of binary numbers. A BER can be measured by sending out and receiving a known PRBS and checking for errors in the received sequence. I will present results of BER testing of gigabit transceiver protocols on Xilinx Virtex 5 LXT50T and LXT110T FPGAs for PHENIX detector electronics upgrades.
DA.00034 CUORE: The Three Towers Test\(^1\)  , ALISON GOODMAN, LAURA SPARKS, California Polytechnic State University
San Luis Obispo, CUORE COLLABORATION\(^2\) — CUORE (Cryogenic Underground Observatory for Rare Events) will be part of the next generation of detectors used to search for neutrinoless double beta decay (0\(\nu\)BB). Located in Assergi, Italy at the Gran Sasso National Laboratory (LNGS), CUORE will be a large cryogenic bolometer composed of 988 tellurium dioxide (TeO\(_2\)) detectors with a total mass of 750 kg, and will search for 0\(\nu\)BB in \(^{130}\)Te. The intermediate upgrade, CUORE-0, first involves the disassembly of Cuoriconio, CUORE’s smaller counterpart in operation since 2003, and the readying of the Three Towers test, a diagnostic detector configuration. As the experiment will monitor the extremely rare event of 0\(\nu\)BB, all factors contributing to background need to be minimized to effectively increase the sensitivity. We assisted the LNGS researchers over the summer of 2006 by supporting R&D work with the Three Towers test to reduce the radioactive background of the experiment. Activities involved decontaminating the copper frame of radon daughters, and chemically etching and lapping the TeO\(_2\) crystals with nitric acid and silicon dioxide, respectively, to remove surface contaminants which contribute to background counts. This work was supported in part by NSF grant PHY-0653284 and the California State Faculty Support Grant.

\(^1\)NSF and California State Faculty Support Grant

\(^2\)We are not official members of the CUORE collaboration.

DA.00035 The Interaction of Nuclei in the Gravitational Fields of Mini Black Holes . LAUREN GREENSPAN, Cyclotron Institute — The goal of this research was to find solutions to the Schrodinger equation that describe particle scattering around black holes of mass 10\(^{-17}\) kg up to a gravitational potential of 10\(^{4}\) GeV. The calculated contribution is the only viable explanation of the observed spin structure through polarized proton-proton collisions. The parity violating decay of W-bosons created in some of these collisions allows for the determination of the left-handed weak coupling constant.

DA.00036 Slow Controls Using the Axiom M5235BCC . TYLER HAGUE, Abilene Christian University — The Forward Vertex Detector group at PHENIX plans to adopt the Axiom M5235 Business Card Controller for use as slow controls. It is also being evaluated for slow controls on FermiLab e906. This controller features the Freescale MC5235 microprocessor. It also has three parallel busses, these being the MCU port, BUS port, and enhanced Time Processing Unit (eTPU) port. The BUS port uses a chip select module with three external chip selects to communicate with peripherals. This will be used to communicate with and configure Field Programmable Gate Arrays (FPGAs). The controller also has an Ethernet port which can use several different protocols such as TCP and UDP. This will be used to transfer files with computers on a network. The M5235 Business Card Controller will be placed in a VME crate along with VME card and a Spartan-3 FPGA.

DA.00037 Experimental Observation of Decay Energy of \(^{12,13}\)Li \(^1\)  , C.C. HALL, P.A. DEYOUING, Hope College, S. MOSBY, A. SPYROU, M. THOENNESSEN, National Superconducting Cyclotron Laboratory. MONA COLLABORATION — Observation is made, for the first time, of unbound states of \(^{12}\)Li and \(^{13}\)Li. The \(^{12}\)Li and \(^{13}\)Li were created using \(^{14}\)Be and \(^{14}\)Be beams, respectively, from the coupled cyclotrons at the National Superconducting Cyclotron Laboratory. \(^{12,13}\)Li decays very rapidly \((10^{-21} s)\) to \(^{11}\)Li and a neutron for \(^{12}\)Li and \(^{13}\)Li and two neutrons for \(^{13}\)Li. The \(^{11}\)Li fragments were carried by the Sweeper, a 4 T superconducting magnet, through a series of charged particle detectors while the coincident neutrons were detected using the Modular Neutron Array (MoNA). Work is currently being done to simulate the resonances observed in the decay spectrum for \(^{12}\)Li with Breit-Wigner line-shapes. Initial results for \(^{12}\)Li will be shown.

\(^1\)Work supported by National Science Foundation Grant PHY0354920.

DA.00038 A study of continuum contribution to dielectron mass spectra at RHIC energies .  , VALERIE HANGER, Iowa State University — The invariant mass distribution of electron-positron pairs is a crucial tool to account for particles which decay in a lepton-like manner such as \(J/\psi\), \(\Upsilon\), and \(\Upsilon\). Most of the background in the measurement of invariant mass comes from combinatorial pairs and can be removed with mixed event or like-sign electron pair distributions. This still leaves some background composed of unlike-sign electron pairs from correlated D and B mesons and from Drell-Yan. In this paper I will present a systematic study of these contributions, known as continuum. I calculated the continuum contribution using the Modular Neutron Array (MoNA). Work is currently being done to simulate the resonances observed in the decay spectrum for \(^{12}\)Li with Breit-Wigner line-shapes. Initial results for \(^{12}\)Li will be shown.

DA.00039 Event Display for the RPC Test Stand at PHENIX .  , CAITLIN HARPER, Muhlenberg College, THE PHENIX EXPERIMENT COLLABORATION — The Pioneering High Energy Nuclear Interaction Experiment (PHENIX) is located on the Relativistic Heavy Ion Collider (RHIC) ring at Brookhaven National Laboratory. One of the ultimate goals at RHIC is to obtain a more accurate understanding of a proton’s intrinsic spin structure through polarized proton-proton collisions. The parity violating decay of W-bosons created in some of these collisions allows for the determination of flavor separated quark distribution functions. Recently, PHENIX has been focusing on the building and installation of Resistive Plate Chambers (RPC’s). These RPC’s are useful in the selection of high transverse momentum muon events from a background of low transverse momentum muon events. However, before the installation of these RPC’s, it is essential to test their efficiency. We have assembled the RPC modules in a cosmic ray test stand and collected data. In order to better analyze the data and reconstruct the events, an event display was produced. The primary focus of this poster is the development of the track reconstruction and event display software.

DA.00040 New measurements of \(\gamma\)-ray branching ratios in the \(\beta^+\) decay of \(^{32}\)Cl .  , MARK HERNBERG, University of Iowa, DAN MELCONIAN, Texas A&M University — We have determined the \(\gamma\)-ray branching ratios in the \(\beta^+\) decay of \(^{32}\)Cl using a high-purity Ge detector at the University of Iowa and the National Superconducting Cyclotron Laboratory. The experimental result for the superallowed decay \(\delta_\beta = (2.0 \pm 0.8)\%\) agrees with the theoretical predictions but is not a stringent test of theory. By measuring the \(\gamma\)-ray branching ratios in the \(\beta^+\) decay of \(^{32}\)Cl (a decay product of \(^{32}\)Ar) the detector efficiencies can be better determined allowing for a more precise determination of \(\delta_\beta\). Furthermore these branching ratios are important in the study of various nuclear decay schemes and transition rates. Previous measurements of the \(\beta^+\) decay of \(^{32}\)Cl are 35 years old and contain uncertainties of up to 40%. Our preliminary results agree with past data and additionally we’ve identified previously unseen branches and reduced the uncertainties by an order of magnitude.

\(^1\)This research was supported by a grant from the National Science Foundation.
DA.00041 Jet Conversion in a Hadronic Gas, AARON HERNLEY, Carnegie Mellon University, RAINER FRIES, Texas A&M University — It has been proposed that flavor conversion of leading jet partons could be used as a probe for the Quark-Gluon Plasma. In order to check the validity of this proposition, the case of a hadronic gas needs to be considered. If the two cases produce different results, flavor conversions could be used to make a stronger case for the creation of a Quark-Gluon Plasma at RHIC. Here we investigate the case of fragmented jets interacting with a hadronic medium and compare with previous results from quark and gluon jets interacting with Quark-Gluon Plasma. We compute the drag coefficients and conversion widths for pions and kaons and use these values to calculate their nuclear modification factor $R_{AA}$ and their elliptic flow $v_2$ at high transverse momentum. We find there is much less suppression in a hadronic gas than in a Quark-Gluon Plasma, but there is still a net conversion of pions into kaons, leading to $R_{AA} > 1$ not expected for Quark-Gluon Plasma. This significant difference between a hadronic medium and a Quark-Gluon Plasma means that jet conversion could be a unique probe for heavy-ion collisions.

DA.00042 An Energy Calibration of the FN Tandem Accelerator Magnet Analyzing System at Notre Dame, ANSEL HILLMER, Valparaiso University — This work established the groundwork for a proper calibration of the magnet analyzing system for the FN Tandem accelerator at the University of Notre Dame. The calibration utilized $(p,n)$ reactions with well-known threshold energies to correlate NMR Frequency with beam energy. A neutron detector composed of three $3\pi$ proportional counters with moderating polyethylene has been constructed to detect the neutrons. To maximize detection efficiency, GEANT4 was employed to determine the optimal dimensions of the moderator. The maximum efficiency was found to occur with a 3-inch moderator half-length, with the efficiency varying by 2.2% over an 11keV proton beam energy range. A preliminary analysis of data from the 27Al$(p,n)27Si$ yields a result of 5.803MeV corresponding to a frequency of 14.64±.01MHz.

DA.00043 Modern Energy Density Functional for Nuclei and Nuclear Matter, ALBERTO HINOJOSA, Tecnológico de Monterrey — We search for a modern energy density functional for nuclei and nuclear matter, based on the Skyrme type effective interaction. This interaction has been widely used for decades and many parameterizations have been realized to best reproduce binding energies, charge root mean square radii, and other properties of nuclei. Now that more experimental data is available, we are able to fit our results to a broader collection of nuclei at and far from the stability line. We implement the Simulated Annealing Method to search for the particular set of Skyrme parameters that best reproduces a collection of nuclear data. The data consist of binding energies, charge root mean square (rms) radii, rms radii for valence neutrons, spin-orbit splittings and breathing mode energies. The results we obtain using this new parameterization are in good agreement with a wide range of experimental measurements.

1Work supported by the National Science Foundation and the U.S. Department of Energy

DA.00044 Laser System and Optical Cavity for the Hall C Compton Polarimeter, ERIC HOLLAND, HALL C COLLABORATION — At Jefferson Lab a polarized electron beam is used to study the properties of nuclei. Currently, in Hall C a Møller Polarimeter is used to measure the electron beam polarization. This process is accurate but measurements cannot be made simultaneously with the main experiment and this leads to the assumption that the polarization remains constant between measurements. To supplement the Møller Polarimeter, Hall C is constructing a Compton Polarimeter, which performs non-destructive electron beam polarization measurement by Compton scattering. The purpose of this research is to optimize the laser component of the Compton Polarimeter. A fiber optic pulsed laser, with the same radio frequency as the electron beam (499MHz), was chosen to improve the luminosity and thus the number of Compton events. The current choice of the laser alone would be adequate for Hall C; however, a higher power system would provide two obvious benefits: the time needed for a measurement would decrease, and the signal to background noise ratio would increase. An optical cavity was proposed to achieve a gain in the laser power. Due to cavity conditions and geometrical restraints, it was determined that a cavity of length 1.2 meters would satisfy the needs of the Compton Polarimeter best. Experimentally, an external cavity could not be coupled to the radio frequency non-mode locked pulsed laser.

1Funded by NSF REU Program

DA.00045 Laser System for Jefferson Lab’s Hall C Compton Polarimeter, ERIC HOLLAND, St.Anselm College/ODU/Jlab — At Thomas Jefferson National Accelerator Facility a polarized electron beam is used to study the properties of nuclei. Currently, in Hall C a Møller Polarimeter is used to measure the electron beam polarization. This process is accurate but during measurements the experiment is interrupted (destructive measurement). Since Møller measurements can only be done at low beam current < 1 microAmp and the experiments typically run near 100 microAmps, one has to assume that the polarization remains constant between measurements. To supplement the Møller Polarimeter, Hall C is constructing a Compton Polarimeter, which performs non-destructive electron beam polarization measurement by Compton scattering. The purpose of this research is to optimize the laser component of the Compton Polarimeter. A fiber optic pulsed laser, with the same radio frequency as the electron beam (499MHz), was chosen to improve the luminosity and thus the number of Compton events. The current choice of laser alone would be adequate for Hall C; however, a higher power system would provide two obvious benefits: the time needed for a measurement would decrease, and the signal to background ratio would increase. A Fabry-Perot optical cavity was proposed to achieve a gain in the laser power. Due to cavity conditions and geometrical restraints, it was determined that a cavity of length 1.2 meters would best satisfy the needs of the Compton Polarimeter. Our results strongly suggest that a gain switched pulsed laser cannot be coupled to an external optical cavity. A possible explanation is that the process of gain switching does not produce a mode-locked pulse train. Within each pulse it is possible that the Gaussian may be coherent but from pulse to pulse the coherence does not hold. Mode locking is necessary for realizing a successful optical cavity.

1Funded by NSF REU Program

DA.00046 PHENIX RPC Production Database, TIMOTHY JONES, Abilene Christian University, PHENIX COLLABORATION — The Pioneering High Energy Nuclear Interaction eXperiment (PHENIX) is located on the Relativistic Heavy Ion Collider (RHIC) ring at Brookhaven National Laboratory. A primary physics goal that can be studied by PHENIX is the origin of the proton spin. One of the types of rare events looked for in the beam at PHENIX are single high transverse momentum muons, which tend to result from the decay of a W boson. Resistive Plate Chambers (RPCs) will be used as a level 1 trigger to select these events from a large background of low transverse momentum muons. As these RPCs are assembled it is necessary to keep track of the individual parts of each RPC as well as data from various quality assurance tests in a way that will allow the information to be easily accessible years to come as the RPCs are being used. This is done through the use of a database and web page interface that can be used to enter data about the RPCs or to look up information from tests. I will be presenting on how we keep track of the RPCs, their parts, and data from quality assurance tests as they are being assembled as well as how we can retrieve this data after it has been stored in the database.
DA.00047 Analysis of Out-of-Plane Measurements of the Fifth Structure Function of the Deuteron1, MATTHEW JORDAN, GERARD GILFOYLE, University of Richmond, CLAS COLLABORATION — We have measured the $D(e,e'n)\pi$ reaction and the asymmetry $A'_{LT}$ associated with the fifth structure function in quasi-elastic electron scattering from deuterium at a beam energy of 2.56 GeV and over the range $Q^2 = 0.1 - 2.0 \text{ GeV}^2$ with the CLAS detector at Jefferson Lab. The data were collected using both magnet polarities to explore different $Q^2$ regions. We extracted $A'_{LT}$ as a function of missing momentum ($p_{miss}$) using spectra weighted by $\sin \phi_{pq}$ where $\phi_{pq}$ is the angle between the electron scattering plane and the plane defined by the ejected proton and 3-momentum transfer. We compared the measured $A'_{LT}$ with a calculation by Jeschonnek and Van Orden by averaging over the $Q^2$ distribution of the CLAS data. The theoretical curves largely agree with the 2.56-GeV data at $Q^2 = 0.6 - 2.0 \text{ GeV}^2$, but diverge from the data for low $Q^2$ ($0.1 - 1.0 \text{ GeV}^2$) and high $p_{miss}$ (greater than 0.4 GeV). To understand the systematic uncertainties on $A'_{LT}$ we varied the positions of the kinematic cuts used to define quasielastic scattering and the final state proton. The results showed systematic uncertainties of about 1% or less in regions of high statistics.

1Work supported by US Department of Energy contract DE-FG02-96ER40980.

DA.00048 A high resolution scintillation detector for nuclear reactor monitoring via antineutrino interactions1, JONATHAN KESSLER, Southeast Missouri State University, REX TAYLOR2, Indiana University, Bloomington — We have constructed a prototype detector employing a novel method using wave-length shifting fibers and liquid scintillator. We evaluate the performance of a 1 cubic-meter device using this technique as a detector of electron antineutrinos from a nuclear reactor. These antineutrinos are measured via the inverse beta decay interaction. We have simulated the device to determine the efficiency and reaction rates for the device placed near a nuclear reactor. We propose that this type of detector will more efficiently veto backgrounds and track antineutrino interactions more effectively than detectors with lesser spatial and energy resolution. This will allow for a more accurate measurement when determining whether a critical amount of plutonium has been removed from the reactor core.

1Work supported by the US National Science Foundation Research Experience for Undergraduates program
2Research Affiliation: Indiana University
3REU Advisor

DA.00049 A Systematic Study of RPC Spacer Bond Strength for PHENIX, JOSEPH KISH, Abilene Christian University, PHENIX COLLABORATION — The Pioneering High Energy Nuclear Interaction eXperiment at Brookhaven National Laboratory is currently undergoing a forward muon trigger upgrade by incorporating large Resistive Plate Chamber tracking stations. The upgrade will make it possible to determine the spin contributions of sea and valence quarks to the spin of the proton. Many aspects of the PHENIX RPC design were borrowed from the Compact Muon Solenoid experiment at CERN. Unfortunately, approximately 5% of CMS gas gaps had gas leaks or failed spacer integrity testing. In order to address the problem of spacer failure, a systematic study of spacer-epoxy-Bakelite bond strength was conducted. Several tests were performed in order to determine the relationship, if any, between various surface treatments, curing temperature, spacer geometry and bond strength. The methods, results and improvements will be discussed.

DA.00050 TPC tracking software for NIFFTE: the Neutron Induced Fission Fragment Tracking Experiment, RYUHO KUDO, J.L. KLAY, California Polytechnic State University, San Luis Obispo, NIFFTE COLLABORATION — Ever since the scientific community started analyzing and filtering data using computers, programming has become a crucial part for the success of many projects. The NIFFTE Collaboration, which is building a Time Projection Chamber (TPC) to study neutron-induced fission of the major actinides, naturally requires a comprehensive software framework to analyze the high volume of data it will collect. Following the traditional TPC reconstruction model, we have written a set of offline analysis algorithms to reconstruct tracks left by the fission fragments in the TPC and determine their (A,Z). We accomplish this by organizing the raw TPC voxel data into 2 dimensional planes, performing cluster and hit-finding within those planes and then connecting the hits to create 3-D tracks. Finally, track fitting and error correction are performed and the fragment A,Z are determined from the distribution of specific ionization along the track. Since one of the goals of this project is to create a re-usable library of TPC reconstruction code that can be adapted to other TPC projects, the software uses open source tools and is built as an object-oriented package in C++. This poster will present the current status of the TPC reconstruction algorithms and discuss the motivations behind our specific programming choices.

DA.00051 Cosmic Ray Study with the Nose Cone Calorimeter1, THOMAS LANGIN, Amherst College, FOR THE PHENIX COLLABORATION — The Nose Cone Calorimeter (NCC) is a proposed upgrade detector for the PHENIX experiment at Brookhaven National Lab. The NCC will be useful for a variety of measurements in polarized p+p, d+A, and A+A collisions at the Relativistic Heavy Ion Collider (RHIC). The NCC is a tungsten-silicon sampling calorimeter, made up of 3 mm tungsten plates sandwiched by 1.5 x 1.5cm$^2$ silicon pads. The NCC would add a new capability to measure the $\chi_c$ meson and electrons from W-boson decays in PHENIX, as well as adding acceptance for the $\pi^0$ and $\gamma$-jet and many other measurements. Since it uses tungsten plates which have a very small Moliere radius of 0.9 cm, the NCC is capable of distinguishing photons down to very small separations, which is essential for the high densities in the heavy ion collisions and for decay photons from very high energy W's. The performance of the most recent NCC prototype was tested using cosmic rays, which deposit close to the lowest energies the NCC needs to measure. We find that the dynamic range of the NCC is within design specifications. Additionally, different methods to reconstruct the energy from the measured signal pulses were studied which will help in optimizing the pulse shaping for the next prototype.

1I acknowledge the Schupf Scholar program of Amherst College for providing me a grant to do this research.

DA.00052 Gamma-Ray Spectroscopy of $^{101}$Pd, JUSTIN LEBLANC, D.A. MEYER, Rhodes College, A. HEINZ, H. AI, R.J. CASPERSON, B. HUBER, WNSL, Yale University, R. LUTTKE, WNSL, Yale University; TU Darmstadt, E.A. MCCUTCHAN, WNSL, Yale University; Argonne National Laboratory, J. QIAN, WNSL, Yale University; B. SHORAKA, WNSL, Yale University; University of Surrey, J. SMITH, Rhodes College, R. TERRY, WNSL, Yale University, J.L. HUGON, Rhodes College, E. WILLIAMS, WNSL, Yale University — Structural evolution is frequently characterized as a function of varying neutron or proton number. The E-Gamma Over Spin (E-GOS) method is a simple way to describe changes in the shape of a specific nucleus as a function of its angular momentum. We performed an experiment using the ESTU tandem Van de Graaff accelerator at the Wright Nuclear Structure Laboratory at Yale University. In the experiment, ~10 different isotopes in the A=100 region were synthesized. This work focuses on $^{101}$Pd and considers it within the framework of the E-GOS method. A summary of the results obtained and an interpretation of their implications in the context of the region will be presented.

1This work was supported by DOE Grant DE-FG-91ER-40609 and Rhodes CARES.
DA.00053 Reducing DAC noise to sub-millivolt level in an effort to lock a high gain Fabry-Perot cavity. LAWRENCE LEE, Rutgers University — Several pending experiments at JLAB Hall A require Compton polarimetry at a higher precision than currently obtainable in the hall, requiring ~1% error in electron polarization measurement. As the frequency of light scattered from the electron beams is increased, the longitudinal asymmetry is decreased as understood within the framework of QED, lowering experimental error. The goal of the project is to create a cavity that resonates with more power and at a higher frequency than the currently implemented setup. Obtaining a PDH-locked, high gain Fabry-Perot cavity that resonates at 1.5 kW of green (532 nm) laser is desired. To combat mechanical fluctuations of the cavity at atomic scales, the feedback loop uses tuning the frequency of the input laser. Many upgrades to our hardware and software are required to lock the cavity over long time periods. To this effect, a digital-analog converter upgrade was performed to implement a 16-bit DAC setup over the current 12-bit DACs to reduce the effect of bit-noise, which currently ripples the bandwidth of the high-gain cavity. The reduction of noise to a level well within the cavity’s bandwidth should allow a more stable lock of the cavity.

DA.00054 Development and Testing of the LED Calibration System for the Daya Bay Antineutrino Detectors. BRIAN LESTER, California Institute of Technology. DAYA BAY NEUTRINO EXPERIMENT COLLABORATION — The Daya Bay Neutrino Experiment requires extremely precise measurements of the antineutrino-neutrino rate and spectrum from the Daya Bay nuclear reactors to produce an accurate measure of the neutrino mixing angle $\theta_{13}$. Such precise measurements require rigorous calibration of each antineutrino detector (which use liquid scintillator in the detecting regions) using both radioactive and LED calibration sources. This project aims to test the feasibility that, by comparing the detector response in a dry run to the liquid run, we can determine the attenuation length of the liquid interior of the detector. Using two photomultiplier tubes (PMTs) attached to the ends of 5 meters of 4” inner diameter PVC pipe, we mock up the interior of the detector with 2” calibration PMTs at the top and bottom of the detector. We then place an LED diffuser ball inside of the PVC pipe via various access holes to model the LED calibration units inside of the detector and pulse the LED as we would for calibration of the detector. We record the response of the PMTs for various positions along the PVC pipe, both with the pipe filled with liquid and with only air inside of the pipe. Comparing the PMT detection ratio for runs in liquid and runs in air we measure the attenuation length of the liquid.

DA.00055 Using Lithium 6 in measuring Giant Monopole Resonance. ANTHONY LICATA1, North Georgia College and State University — Finding the Isoscalar Giant Monopole Resonance (ISGMR) is one of the ways to determine the compressibility of nuclear matter (Knm). This Knm is used to find the equation of state for nuclear matter and in astrophysics concerning supernova and neutron stars. To determine this Knm more accurately, we need to survey the ISGMR for many nuclei. To study unstable isotopes the inverse reaction has to be studied. Finding the ISGMR has been done in the past with alpha scattering. For the inverse reaction using a 4He gas as a target is problematic so a Lithium (6Li) target could be a solution. For this reaction to be studied a new detector needs to be built which can measure the different products of the reaction in the test chamber. Thanks to the Youngblood Group at the Cyclotron Institute, TAMU.

1Mentor: Dr. David Youngblood

DA.00056 Preparatory Low-Background Assay Analysis. ALEX LONG, The University of North Carolina - Chapel Hill, and Trinity Universities Nuclear Laboratory, UNC - CHAPEL HILL PARTICLE ASTROPHYSICS TEAM — Confirmation of previous observational claims of neutrino-less double-beta decay ($0\nu\beta\beta$) by Klappoder and Kleingrothaus could have tremendous physical implications. This includes: violation of lepton number conservation in the Standard Model, measurement of the $0\nu\beta\beta$ decay-rate, improved limits in the measurement of the Majorana mass of the electron neutrino, and support for the theoretical consideration that the neutrino is its own antiparticle. The Majorana Collaboration will use enriched Ge-76 crystals in a low-background environment, to probe below the current upper limits of the neutrino-mass region. Our sub-group is performing a materials assay for the Majorana experiment, using two High Purity Germanium (HPGe) coaxial detectors located in the Kimbalton Underground Research Facility (KURF). My contribution is primarily in the quantitative analysis and identification of prominent contaminants found in the construction materials being used in the Majorana experiment. This is achieved by comparison of Gamma-ray spectra to known radioactive decay-chains and creating consistent methods for computing the absolute activities of contaminants using efficiencies found from Monte Carlo simulation.

DA.00057 Activity Calculations using HPGe Detectors and Monte Carlo Efficiencies. KEVIN MACON, UNC-CH Experimental Particle Astrophysics Group — The next generation of experiments in particle astrophysics will require extremely low and well-known backgrounds. This requires performing experiments with low activity materials and going underground to escape the ubiquitous cosmic-ray background. Current radiating materials always using low background HPGe detectors at the recently established Kimbalton Underground Research Facility for Low Background Counting (KURF LBC) examines the bulk activity of materials that will be used in the detector and pulse the LED as we would for calibration of the detector. To study this background, an angular distribution of the cosmic rays was found, and the rate at which cosmic rays muons “rain” upon the detector was calculated. In addition, the cosmic rays were used to examine the timing differences between individual scintillators.

DA.00058 Cosmic Ray Background Analysis for MuLAN. MICHAEL MANGIALARDI, University of Illinois at Urbana-Champaign — The goal of the MuLAN experiment is to make a measurement of the muon lifetime to a precision of 1 ppm so that a 5 ppm value of the Fermi coupling constant can be calculated. To do this, a beam of positive muons is stopped in a target surrounded by 340 scintillating detectors arranged in a geodesic around the target. Once the muons stop in the target, they decay, and the product positrons are emitted outward, where they are detected by the scintillators. By examining the spectrum of decay times, the lifetime of positive muons can be calculated. One of the myriad factors affecting this measurement is the background of cosmic ray muons constantly showering upon the detector. To study this background, an angular distribution of the cosmic rays was found, and the rate at which cosmic ray muons “rain” upon the detector was calculated. In addition, the cosmic rays were used to examine the timing differences between the individual scintillators.

DA.00059 Search for the $2^+$ to $0^+$ Transition in $^{158}$Gd. M.C. MARSHALL, R.J. CASPERSON, V. WERNER, A. HEINZ, A. SCHMIDT, J. QIAN, J.R. TERRY, E. WILLIAMS, R. WINKLER, WNSL Yale, Z. BERANT, WNSL, NRC Negev, M. BUNCE, WNSL, Surrey, G. HENNING, WNSL, ENS Cachan, M. SMITH, WNSL, CCSU — Interacting Boson Model 1 (IBM) calculations on Gd nuclei indicate that the 2$^+$ state in $^{158}$Gd is a cavity that resonates with more power and at a higher frequency than the currently implemented setup. Obtaining a PDH-locked, high gain Fabry-Perot cavity that resonates at 1.5 kW of green (532 nm) laser is desired. To combat mechanical fluctuations of the cavity at atomic scales, the feedback loop uses tuning the frequency of the input laser. Many upgrades to our hardware and software are required to lock the cavity over long time periods. To this effect, a digital-analog converter upgrade was performed to implement a 16-bit DAC setup over the current 12-bit DACs to reduce the effect of bit-noise, which currently ripples the bandwidth of the high-gain cavity. The reduction of noise to a level well within the cavity’s bandwidth should allow a more stable lock of the cavity.


1Supported by US DOE grant no. DE-FG02-91ER40609.
DA.00060 Commissioning Measurements of ORRUBA Detectors1, C.T. MATTHEWS, J.A. CIZEWSKI, P.D. O’MALLEY, Rutgers University, S.D. PAIN, Oak Ridge National Laboratory — The Oak Ridge Rutgers University Barrel Array (ORRUBA) is a silicon detector array being developed by the Center of Excellence for Stewardship Science at Oak Ridge National Laboratory. The array is comprised of two rings of position-sensitive detectors in a cylindrical setup designed to maximize solid angle coverage for (d,p) measurements in inverse kinematics. Each detector has 4 resistive strips, with readout from each strip-end. At forward angles, detector telescopes are used, comprised of a thin non-resistive detector (65μm) for transmission backed by the thicker resistive detector (1000μm) for stopping, allowing particle identification in addition to measurement of the angle and energy of the detected particles. For commissioning, the problem was to test the idea that it is functioning properly, and to understand its optimal bias voltage and energy resolution. Measurements of leakage current profiles, full-depletion voltages and energy resolution measurements have been completed. The details of the array, its motivation and these commissioning measurements will be reported.

1Supported by the US Department of Energy

DA.00061 Determination of Observables from Double-Polarization Photoproduction, RANDALL MCCLELLAN, Florida State University, CLAS COLLABORATION — A key technique in the study of poorly established and unobserved baryon resonances is polarization observables in meson production experiments. These asymmetries, sensitive to weak resonance contributions, will provide additional constraints and therefore eliminate ambiguous solutions characteristic of unpolarized data. In addition, the majority of our "baryon" knowledge is based on pion-nucleon scattering experiments. By employing photoproduction, states that have proved elusive due to weak coupling to pion-nucleon interactions may be more easily seen. The combination of a polarized photon beam and polarized target provides a unique and unprecedented look into the excited states of the nucleus. The CEBAF Large Acceptance Spectrometer (CLAS) at Jefferson Laboratory, Newport News, Virginia, is an excellent tool for observing circularly and linearly polarized light incident on a longitudinally-polarized frozen spin butanol target (FROST). CLAS has accumulated double-polarization data from November 2007 to February 2008 and the debut of the butanol target has exceeded expectations. The FROST data provide (nearly) complete experiments for a variety of different photoproduction reactions. This contribution will present the status of the experiment and outline plans for the determination of polarization observables in double-pion production.

DA.00062 New results on the excited states in $^{32}$Mg, A.J. MCGAULEY, University of Notre Dame, H. MACH, Uppsala U., L.M. FRAILE, U. of Complutense Madrid, O. TENGBLAD, R. BOUTAMI, CSIC Madrid, C. JOULIET, IRES Strasbourg, W. PŁOCIENNIK, ASINS Swierk, D.Z. YORDANOV, U. of Leuven, M. STANOIU, IPNO Orsay, FOR THE IS441 COLLABORATION — $^{32}$Mg is located at the center of a region known as the "island of inversion," a region in which the classic picture of stable shell structure was shattered when the energy of the 2$^+$ state in $^{32}$Mg was found to be only 885 keV, much lower than expected for a nucleus with a closed neutron shell. The collapse of the $N=20$ shell closure has been extensively studied, yet very little information exists on the excited states in $^{32}$Mg, which is the critical nucleus. We have studied the levels in $^{32}$Mg populated from the beta-decay of $^{32}$Na at the ISOLDE facility at CERN. We have established a new level scheme which includes 9 excited states and 18 transitions based on the gamma-gamma coincidences. The statistics exceeded by about 2 orders of magnitude statistics collected in previous measurements of $^{32}$Mg [1]. We do not confirm two levels previously proposed, while two new levels and five new transitions are included in the level scheme. [1] G. Klotz et al., Phys. Rev. C47, 2502 (1993), C.M. Mattoon et al., Phys. Rev. C75, 017302 (2007), and V. Tripathi et al., Phys. Rev C77, 034310 (2008).

DA.00063 Determination of Impact Parameter for Fermi Energy Heavy Ion Collisions Using the HIPESE Event Generator1, MICHAEL MEHLMAN, Rice University, ZACH KOHLEY, SHERRY YENNELLO, Texas A&M Cyclotron Institute — In order to determine the impact parameter of a nuclear collision (a quantity that cannot be observed directly), one must first verify the method for doing so. This is only possible using a theoretical model that provides realistic observables associated with a known impact parameter, such as the HIPESE (Heavy-Ion Phase-Space Exploration) event generator. For four systems, HIPESE-generated observable distributions were mapped to the geometrical impact parameter distribution, providing probable event impact parameter ranges, which were then compared with the theoretical impact parameter. Numerous quantities were considered for correlation, several of which ultimately proved useful, such as charged particle, neutron, and total particle multiplicity, as well as total event transverse momentum. For observables, charged particle and neutron multiplicities, intermediate to light fragment ratio, and total event transverse momentum, were then chosen to train a Neural Network to refine the impact parameter prediction. The output of the Neural Network showed better correlation than the theoretical impact parameter. Numerous quantities were presented for correlations stemming from both the mapping and Neural Net analyses.

1Special thanks to: NSF, DOE

DA.00064 REACLIB: A Reaction Rate Library for the Era of Collaborative Science, ZACHARY MEISEL, NSCL at MSU — Thermonuclear reaction rates and weak decay rates are of great importance to modern nuclear astrophysics. They are critical in the study of many topics such as Big Bang Nucleosynthesis, X-ray bursts, Supernovae, and S-process element formation, among others. The Joint Institute for Nuclear Astrophysics (JINA) has been created to increase connectivity amongst nuclear astrophysicists in our modern age of highly collaborative science. Within JINA there has been an effort to create a frequently updated and readily accessible database of thermonuclear reactions and weak decay rates. This database, the JINA REACLIB, its motivation and these commissioning measurements will be reported.

DA.00065 Precision Measurement of Target Mass in the Antineutrino Detectors of the Daya Bay Reactor $\theta_{13}$ Experiment, PATRICK MENDE, University of Wisconsin — Of the parameters within the neutrino mixing matrix, the reactor neutrino experiment at Daya Bay seeks to determine the yet unknown neutrino mixing angle $\theta_{13}$ to a sensitivity of 0.01 or better in $\sin^2\theta_{13}$. The result would be production of induced depletions of the 418 year isomer $^{108m}$Ag may be possible, caused by providing an input of 255 keV or 413 keV. The result would be production of additional ground state nuclei with a half-life of 2.37 minutes, leading to beta decay. An experiment has been designed to measure beta decay of $^{108m}$Ag after exposure of an isomeric sample to 450 keV bremsstrahlung. Because beta particles are attenuated by air, a clean vacuum chamber was assembled with which to use a Si(Li) detector. The aim of this experiment is to observe an increased rate of beta decay after several minutes of direct exposure to bremsstrahlung radiation.

DA.00066 Experimental system to search for induced depletion of $^{108m}$Ag, ISAAC MILLS, THOMAS HARLE, GEOFFREY TREES, JAMES CARROLL, Youngstown State University — Nuclear isomers may provide high density energy storage media for specialized batteries. The key would be to identify a way to release the stored energy when desired, by depleting the isomer population. Existing nuclear data [1] suggest that an induced depletion of the 418 year isomer $^{108m}$Ag may be possible, caused by providing an input of 255 keV or 413 keV. The result would be production of additional ground state nuclei with a half-life of 2.37 minutes, leading to beta decay. An experiment has been designed to measure beta decay of $^{108m}$Ag after exposure of an isomeric sample to 450 keV bremsstrahlung. Because beta particles are attenuated by air, a clean vacuum chamber was assembled with which to use a Si(Li) detector. The aim of this experiment is to observe an increased rate of beta decay after several minutes of direct exposure to bremsstrahlung radiation.

DA.00067 Double beta decay Q-values of $^{130}$Te, $^{128}$Te, and $^{120}$Te. JESSICA MINTZ, UC Berkeley, ERIC NORMAN, UC Berkeley, LLNL, NICHOLAS SCIELZO, LLNL, CANADIAN PENNING TRAP COLLABORATION — The observation of neutrinoless double-beta decay would constrain the absolute neutrino mass scale, determine whether or not the neutrino is its own antiparticle, and imply that lepton number is not conserved. In order to search for this elusive decay, the CUORICINO and CUORE experiments at Gran Sasso National Laboratory use $^{208}$Tl bolometers to measure the temperature increase from radioactive decays in the crystals. Since the signature of neutrinoless double-beta decay is a peak at the full decay energy Q-value, it is critical to measure this energy to a very high precision. The three isotopes of natural Te which undergo double beta decay are $^{130}$Te to $^{130}$Xe, $^{128}$Te to $^{128}$Xe, and $^{120}$Te to $^{120}$Sn. Mass differences between each of these parent and daughter nuclei have been measured using the Canadian Penning Trap Mass Spectrometer at Argonne National Laboratory to within 0.5 keV. The method by which nuclear masses are measured with the Penning trap will be described. Preliminary results for the double beta decay Q-values of $^{130}$Te, $^{128}$Te, and $^{120}$Te will be presented.

DA.00068 Study of Inelastic Background for Quasielastic Scattering from Deuteron at 11 GeV$^1$. MARK MOOG, GERARD GILFOYLE, University of Richmond, CLAS COLLABORATION — The magnetic form factor of the neutron is a fundamental quantity of nuclear physics that describes the distribution of charge and magnetization within the neutron, yet there are only limited data for this form factor in the Q$^2$ range 5-14 GeV$^2$. Experiment E12-07-104 at Jefferson Lab is planned to measure $G_n^e$ in this Q$^2$ range after the 12-GeV Upgrade using the ratio method. This technique uses the ratio of quasielastic $e - n$ to $e - p$ scattering on deuterium, knowledge of the well-known proton elastic cross section, and accurate calculations of nuclear effects to extract $G_n^p$. The effect of the neutron elastic form factor is small. The method has worked well at lower Q$^2$. To further study this future experiment we simulate the Fermi motion of nucleons in the deuteron and use the known behavior of the nucleon elastic form factors to calculate the quasielastic cross section. For inelastic events we use the same model for the deuteron and the GENEV program to calculate the number of events. We have simulated the experiment at the limit of the anticipated Q$^2$ range, studied the effects of various cuts, and investigated strategies for reducing the inelastic background in the quasielastic region.

1Work supported by US Department of Energy contract DE-FG02-96ER40980.

DA.00069 An interactive website for the nuclear shell model: Concordia$^1$. DAVID MORRIS, ALEXANDER VOLYA, Department of Physics, Florida State University — The nuclear shell model has become a standard theoretical approach to study nuclear many body systems. Shell model calculations using well-established interactions provide a powerful tool for nuclear experiments. Although some shell model results are tabulated, on demand calculations are increasingly important. In order to facilitate extensive calculations, result storage, and analysis, we have developed a web-based interactive interface for the shell model code CoSMo. The web portal allows calculation of nuclear levels with a number of interactions and valence spaces. It also permits analysis of occupation numbers, spectroscopic factors, and electromagnetic transition rates.

2http://cosmo.volya.net


DA.00070 Impact of Polycarbonate Spacers on Resistive Plate Chamber Efficiencies, NICHOLAS MUCIA, University of Illinois Urbana / PHENIX — The PHENIX experiment at the Relativistic Heavy Ion Collider at Brookhaven National Laboratory will measure the flavor dependent quark and anti-quark polarizations in the proton through parity violating W-production. A new dedicated muon trigger spectrometer is being built to select high momentum muons from the decay of W bosons. The muon spectrometer relies on Resistive Plate Chambers (RPCs) developed for the CMS experiment at the Large Hadron Collider. PHENIX continues to pursue detailed studies of CMS RPC technology to ensure that these detectors will be optimally deployed and operated in PHENIX. In this poster we present two dimensional efficiency measurements with cosmic rays in RPC prototypes. In particular we have studied the impact of polycarbonate spacers used to define the 2 mm wide RPC gas gaps have on the detector efficiency. We will present two dimensional efficiency measurements in the region adjacent to the spacers including the radial dependence of the efficiency with respect to the center of the spacer.

DA.00071 Gamma Detection Efficiency of a State-of-the-Art Ge Detector. ERIKA NAVARRO, CARL GAGLIARDI, ADRIANA BANU, Wellesley College — An experiment to determine the ground spin of the exotic nucleus $^{23}$Al is presented. By analyzing the spectra of the emitted gamma rays of the core nucleus $^{22}$Mg arising from the reaction $^{22}$Mg($^3$He,$^α$)$^{23}$Al, the higher energy levels of the $^{22}$Mg and their associated spin (j) values are determined. Subsequently, the need to precisely calibrate the EXOGAM Ge clovers to accurately determine these gamma ray energies, and therefore draw conclusions about the separation between nuclear shell levels, is met. Using careful analysis of gamma ray spectra and precise calibration of Ge detectors, resulting momentum distributions indicate a ground state spin of 5/2$. This both rejects the theory of halo structure of the $^{23}$Al exotic nucleus, and is consistent with previous experimental results strengthening the case for the use of mirror symmetry in nuclear astrophysics in systems otherwise not accessible.

DA.00072 Development of the Low Energy Neutron Detector Array (LENSDA) for the Study of Charge-Exchange Reactions at the NSCL, DU NGUYEN, Michigan State University, S.M. AUSTIN, D. BAZIN, C. CAESAR, J.M. DEAVEN, C.J. GUESS, G.W. HITT, R. MEHARCHAND, G. PERDIKAKIS, R.G.T. ZEGERS, NSCL, CHARGE-EXCHANGE TEAM — Charge-exchange reactions have long been used as a probe of the spin-isospin response of stable nuclei, in particular the Gamow-Teller transitions. Gamow-Teller strengths can be extracted model-independently, providing detailed information on nuclear structure and key inputs for astrophysical scenario that involve weak transitions. Therefore, it is important to extend the charge-exchange studies to unstable nuclei. The Low Energy Neutron Detector Array (LENSDA) is currently in development at the NSCL and is designed to facilitate the study of ($^p$, $^n$) charge-exchange reactions in inverse kinematics using unstable beams. The energy and angle of the recoiling neutrons from these reactions can be measured by LENDA and used for kinematical reconstruction of charge-exchange each event. For this purpose, good timing and position resolutions should be achieved in LENDA. Currently, an initial array consisting of three $30\times30\times5\times5$ plastic scintillators has been developed. The final LENDA array will consist of 24 such scintillators designed to detect neutrons with energies as low as 100 keV. In addition, the proper light output function must be extracted to determine the correct efficiency of the detectors. Results from ongoing work on the development of the array will be presented. This work was supported by the US NSF, grants PHY-0606007 and PHY 0216783 (JINA).
DA.00073 Determining the polarization of $^3$He by means of an optical technique. TIMOTHY NICHOLS, Hendrix College — An experiment now being developed will increase the accuracy of the current neutron electric dipole moment (EDM) measurement by a factor of 100. In order to obtain this new level of accuracy, a system of polarized ultra-cold neutrons (UCN) and $^3$He is being used. The UCN's and $^3$He are placed in a combined magnetic and electric field where their relative precession rate is measured using the spin-dependent n–$^3$He capture reaction. Any change in the precession rate when the electric field is reversed is attributable to an EDM. The polarization of the $^3$He must be maintained at as high a level as possible, and a variety of materials are being tested to determine their wall depolarization probabilities. In order to understand the ultimate sensitivity of these measurements, the initial polarization of the $^3$He, produced by optical pumping of a discharge, must be known. In this paper we present a measurement of the circular polarization of light from the 667 nm transition in He in a standard pumping cell. The polarization in this transition is induced by the nuclear polarization via the hyperfine interaction; the degree of polarization has been previously calibrated by comparing with absolute nuclear magnetic resonance measurements.

DA.00074 Precise measurements of $\alpha_k$ for the 346.5 keV M4 transition from $^{197}$Pt$^m$: A test of internal conversion theory$. J. NOLAN, Centenary College of Louisiana, N. NICA, J.C. HARDY, Texas A&M University Cyclotron Institute, M. HERNBERG, University of Iowa, J.R. GOODWIN, V.E. IACOB, Texas A&M University Cyclotron Institute — Precise values for internal conversion coefficients (ICCs) are important in the study of nuclear decay schemes; they also are useful for detector efficiency calibration. A recent survey revealed that few measured ICCs are known to a high precision ($\sim 1\%$); in addition, there is some theoretical uncertainty over how to deal with the atomic vacancy left by the departing electron during the internal conversion process. Texas A&M has previously precisely measured the ICCs for $^{193}$Ir, $^{137}$Ba, and $^{134}$Cs as a test of internal conversion theory; we now consider the ICC for $^{197}$Pt$^m$ as a further test. The $^{197}$Pt$^m$ was produced by thermal neutron activation of separated $^{197}$Pt (97.43% pure). Two separate sources were produced: $\gamma$-ray and gamma-ray emissions from each source were recorded by a High Purity Germanium Detector (+/- 0.20% absolute efficiency uncertainty). After impurity subtraction and attenuation correction, preliminary results for the $\alpha_k$ value for the two sources have now been obtained. The $\alpha_k$ from source one is 4.24 (13); the $\alpha_k$ from source two is 4.26 (8). While these values are still tentative, the results show agreement with the theory that considers the atomic vacancy.

DA.00075 Neutron-Deuteron Breakup and Quasielastic Scattering. ALICE OHSLON, JUNE MATTHEWS, WILBUR FRANKLIN, BRIAN DAUB, Massachusetts Institute of Technology, TAYLAN AKDOGAN, Bogazici University, Istanbul, MARK YULY, STEVEN WALLACE, STEPHEN THOMSON, DANIEL HAAS, Houghton College — Quasielastic scattering in the 200 MeV region is studied by impinging a pulsed neutron beam on a deuterium target at the Los Alamos National Laboratory. The scattered neutrons from the d(n,np)n reaction are detected by a wall of neutron time-of-flight scintillators, and scattered protons are detected by a permanent magnet spectrometer with two sets of wire chambers. This setup allows for measurement of incident neutron energy, scattered neutron energy, and scattered proton energy, as well as scattering angle and position for all scattered particles. The results of the experiment are compared with a Monte Carlo simulation of quasielastic scattering, to observe the differences between two-body elastic and three-body quasielastic collisions.

DA.00076 Investigating Background Sources in the DIANNA Experiment using GEANT4 and MCNPX$. CATRISH PAGAN, RICHARD SHOWALTER-BUCHER, DAVID YAGER-ELORRIAGA, BRET CRAWFORD, SHARON STEPHENSON, Gettysburg College, DIANNA COLLABORATION — The DIANNA collaboration is pursuing a direct measurement of the $^{15}$N-neutron scattering length at the YAGUAR reactor. The neutron background is predicted to depend linearly on the neutron flux, while the neutron-neutron signal should have a quadratic dependence, and therefore, variation in the pulse power of the reactor provides a mechanism for separating the signal from the background. Initial measurements show a non-linear contribution to the background, which could be from both desorption in the aluminum vacuum pipe as well as physical movement of the moderator during the reactor pulse. To study the background effects of various desorption processes, GEANT4 was used. MCNPX was used to model the possible background effects of the moderator movement during the YAGUAR reactor pulse. Results will be presented.

DA.00077 RF Quadrupole Ion cooler for negative ions$. JACQUES PAPE, YUAN LIU, Oak Ridge National Laboratory, TOM LEWIS — In order to improve the quality of radioactive ion beams (RIBs), radio frequency (RF) quadrupole ion coolers are being developed for reducing the energy spreads and, consequently, the emittances of negative RIBs. RF quadrupole ion coolers are RF-only quadrupole ion guides filled with a buffer gas. The ions can be cooled by collisions with lighter buffer gases and their radial trajectories can be reduced to a small region near the axis of the device while the ions are inside the RF quadrupole ion cooler. Studies have been conducted to determine the operation parameters and the transmission of two ion coolers of quadrupole rod size of 11.48 mm diameter and 8 mm diameter, which are equipped with provisions for both retarding energetic negative ion beams to energies below thresholds for electron detachment at injection and re-accelerating negative ion beams to high energies after the cooling process. After mass separation, the ions of a selected mass are focused into the ion coolers where they are slowed by collisions with He buffer gas. At the exit of the cooler, the ions are re-accelerated to their original energies and measured with a Faraday cup detector. The performances of the two coolers are characterized with O$^-$, OH$^-$, F$^-$, S$^-$, Cl$^-$, Ni$^-$, Co$^-$, and Cu$^+$ ions. The analysis results gathered from the two RF quadrupole ion coolers will be presented.

DA.00078 Simulation of d(7Be,t)6Be with Fresco, and investigation of resonant states of 6Be. TIMOTHY PELHAM, ORNL, University of Rutgers, University of Surrey — An ongoing study is presented into the resonant states of 6Be via simulation of d(7Be,t)6Be with Fresco to investigate the results of "Searching for resonances in the unbound 6Be nucleus", a paper by K.V. Chae [1]. In this paper the d(7Be,t)6Be reaction was studied to search for resonances in the 6Be nucleus that may be used to increase our knowledge of the 3He(3He,2p)4He reaction. A 100-MeV 7Be beam from the Holifield Radioactive Ion Beam Facility (HRIBF) was used to bombard C2 targets, and tritons were detected by the Silicon Detector Array (SIDAR). It was concluded that a combination of reaction mechanisms are necessary to account for the observed triton energy spectrum. This will be further investigated by simulating the various reaction mechanisms with Fresco to try to reproduce and explain these results. Preliminary Results will be presented.

DA.00079 The Astrophysical $^{187}$Re/$^{187}$Os Ratio: Measurement of the $^{187}$Re(n,2n)$^{186}$Re Destruction Cross Section. ERIC POOSER, North Georgia College and State University, A. HUTCHESON, H. KARWOWSKI, J. KELLEY, E. KWAN, C. HUIBREGTSE, A. TONCHEV, W. TORNOW, TUNL, F. KONDEV, S. SHU, Argonne National Laboratory — We have continued a program of d(7Be,t)6Be with Fresco to investigate the results of "Searching for resonances in the unbound 6Be nucleus" a paper by K.V. Chae [1]. In this paper the d(7Be,t)6Be reaction was studied to search for resonances in the 6Be nucleus that may be used to increase our knowledge of the 3He(3He,2p)4He reaction. A 100-MeV 7Be beam from the Holifield Radioactive Ion Beam Facility (HRIBF) was used to bombard C2 targets, and tritons were detected by the Silicon Detector Array (SIDAR). It was concluded that a combination of reaction mechanisms are necessary to account for the observed triton energy spectrum. This will be further investigated by simulating the various reaction mechanisms with Fresco to try to reproduce and explain these results. Preliminary Results will be presented.

DA.00080 The Astrophysical $^{187}$Re/$^{187}$Os Ratio: Measurement of the $^{187}$Re(n,2n)$^{186}$Re Destruction Cross Section. ERIC POOSER, North Georgia College and State University, A. HUTCHESON, H. KARWOWSKI, J. KELLEY, E. KWAN, C. HUIBREGTSE, A. TONCHEV, W. TORNOW, TUNL, F. KONDEV, S. SHU, Argonne National Laboratory — We have continued a program of d(7Be,t)6Be with Fresco to investigate the results of "Searching for resonances in the unbound 6Be nucleus" a paper by K.V. Chae [1]. In this paper the d(7Be,t)6Be reaction was studied to search for resonances in the 6Be nucleus that may be used to increase our knowledge of the 3He(3He,2p)4He reaction. A 100-MeV 7Be beam from the Holifield Radioactive Ion Beam Facility (HRIBF) was used to bombard C2 targets, and tritons were detected by the Silicon Detector Array (SIDAR). It was concluded that a combination of reaction mechanisms are necessary to account for the observed triton energy spectrum. This will be further investigated by simulating the various reaction mechanisms with Fresco to try to reproduce and explain these results. Preliminary Results will be presented.
DA.00080 Storing Data from Qweak—A Precision Measurement of the Proton’s Weak Charge, TIMOTHY POTTE, Hendrix College, QWEAK COLLABORATION — The Qweak experiment will perform a precision measurement of the proton’s parity violating weak charge at low Q-squared. The experiment will do so by measuring the asymmetry in parity-violating electron scattering. The proton’s weak charge is directly related to the value of the weak mixing angle—a fundamental quantity in the Standard Model. The Standard Model makes a firm prediction for the value of the weak mixing angle and thus Qweak may provide insight into shortcomings in the SM. The Qweak experiment will run at Thomas Jefferson National Accelerator Facility in Newport News, VA. A database was designed to hold data directly related to the measurement of the proton’s weak charge such as detector and beam monitor yield, asymmetry, and error as well as control structures such as the voltage across photomultiplier tubes and the temperature of the liquid hydrogen target. In order to test the database for speed and stability, it was filled with fake data that mimicked the data that Qweak is expected to collect. I will give a brief overview of the Qweak experiment and database design, and present data collected during these tests.

DA.00081 Production and Quality Control Improvements in the Fabrication of Diamond-Like-Carbon Guides, DAVID RICHARDSON, RUSSELL MAMMEI, BRUCE VOGELLAAR, MARK PITT, UCNA COLLABORATION — Stemming from the search for physics beyond the Standard Model, the goal of the UCNA collaboration is to obtain the value of Vud. The weak and axial vector coupling constants provide an effective means of determining Vud but require knowledge of the angular correlation between the spin vector of the neutron and the momentum vector of the reaction during beta-decay (the “Dalitz probability”). This requires analysis of the reaction asymmetry, which is sensitive to the weak magnetic dipole moment of the neutron, and to the spin-dependent weak neutral-current scattering asymmetry, which is sensitive to the weak electric dipole moment of the neutron. Improved monitoring diagnostics, and a new drive mechanism have been implemented yielding improved guide quality. Furthermore, the use of X-ray spectroscopy for UCNA experiments. UCN require transport guides exhibiting the properties of being minimally depolarizing, nonmagnetic, nonconductive, possessing a high Fermi potential and high specularity. Experiments have shown that quartz tubes coated with Diamond-Like Carbon (DLC) are exceptional in the aforementioned categories. Recent improvements in the production process at Virginia Tech, including a refined cleaning procedure, the installation of a target rastering system, will be presented.

DA.00082 Separating the Spin States of a Free Electron Beam, NEIL RIFKIN, University of Connecticut — In 1922 Otto Stern and Walther Gerlach set out to test the spatial quantization of the electron by passing a beam of neutral silver atoms through a transverse magnetic field. The interaction of the two projections of the electron’s magnetic moment with the magnetic field resulted in a splitting of the beam. However, for some sixty years it was generally accepted that the spin of free electrons, and thus their magnetic moment, could not be measured with an experiment similar to that of Stern and Gerlach. The reason being that the Lorentz force on charged particles is far greater than the force due to the magnetic moment of the electron, thus blurring any desired results. To reduce the Lorentz force, the electrons could be passed through a magnetic field whose gradient is in the direction of the electrons’ momentum. This longitudinal Stern-Gerlach device, with a superconducting magnet, could polarize the tails of a low energy electron beam.

DA.00083 Simulation of Velocity Filters in the Daresbury Recoil Separator at the HRIBF, J.P. ROGERS, R.L. KOZUB, Tenn. Tech. U., S.D. PAIN, M.S. SMITH, D.W. BARDAYAN, Y. LIU, ORNL, M. MATOS, LSU — The Daresbury Recoil Separator (DRS) at Oak Ridge National Lab’s (ORNL) Holifield Radioactive Ion Beam Facility (HRIBF) is used for the study of nuclear reactions of astrophysical importance. For example, the DRS allows direct measurements of proton capture reactions on radioactive ions which occur in stellar explosions such as novae and X-ray bursts. The DRS uses velocity filters (V filters) that are tuned to minimize systematic errors. Ultra-Gold Neutrons (UCN) were adopted for UCNA experiments. UCN require transport guides exhibiting the properties of being minimally depolarizing, nonmagnetic, nonconductive, possessing a high Fermi potential and high specularity. Experiments have shown that quartz tubes coated with Diamond-Like Carbon (DLC) are exceptional in the aforementioned categories. Recent improvements in the production process at Virginia Tech, including a refined cleaning procedure, the installation of a target rastering system, will be presented.

DA.00084 Neutron damage tests of a GRETINA prototype detector, T.J. ROSS, C.W. BEAUSANG, University of Richmond, J.Y. LEE, A.O. MACCHIAVELLI, S. GROS, M. CROMAZ, R.M. CLARK, P. FALLON, HENRIK JEPPESEN, Lawrence Berkeley National Lab., J.M. ALLMOND, University of Richmond — Gamma ray energy tracking arrays such as GRETINA/GRETA and AGATA are the latest evolution in gamma ray detection. By locating the interaction points, in 3-dimensions, of individual gamma ray interactions such arrays allow the energies of gamma rays to be reconstructed. This leads to excellent energy resolution, superior peak-to-total ratio and photo peak efficiency and resolving powers up to a thousand times superior to the best current generation array. The position information is extracted from the detailed pulse shapes recorded in each segment. It is anticipated that these tracking-detectors will experience significant neutron fluxes during in beam experiments. Thus it is important to test the response of highly-segmented Ge detectors when subjected to high-energy neutrons. In a one week test carried out at the 88-Inch Cyclotron at LBNL the P3 prototype detector for the GRETINA array was exposed to a neutron flux equivalent to at least one and a half years normal use. The detector was then successfully annealed. Preliminary results for the energy and position resolution, prior to and after neutron damage, and after annealing, will be presented.

DA.00085 Crosstalk Studies of a Time Projection Chamber, JONATHAN RYER, University of Illinois Urbana-Champaign — The crosstalk between various pads of a Time Projection Chamber (TPC) developed for the experiment MuSun was studied. Crosstalk between TPC pads must be studied and understood in order for proper muon path reconstruction to be obtained. A printed circuit board was developed to use capacitive coupling to transmit a signal pulse onto the TPC, where the crosstalk of the transmitted signal was studied.

DA.00086 Transmission Line Properties of Nickel-Bodied Proportional Counters, JENNIFER RYU, Georgia Tech, SNO COLLABORATION — Simultaneous measurements of neutral current and charged current neutrino scattering events allowed the Sudbury Neutrino Observatory (SNO) to demonstrate definitively neutrino oscillation. The three phases of the SNO detector are distinguished by different techniques of detecting the neutrons produced by neutral current neutrino scattering. In the final phase, nickel-bodied proportional counters filled with \(^{3}\)He were used as neutral current detectors (NCDs) by observing the charged particles produced by neutron capture on \(^{3}\)He. If we can understand the electrical transmission properties of the NCDs, we can use the different pulse shapes produced by neutron captures compared to those of alphas to distinguish these events and gain more sensitivity to the neutral current events. We found that because of the ferromagnetism of the nickel, standard calculations provided for proportional counters are not accurate enough. To obtain a better calculation, we directly measured the electrical properties of the transmission line as a function of frequency. This is a presentation of our results.
DA.00087 Analyzing power and yield measurements of the $^{13}$C(d,n)$_0$$^{14}$N Reaction between 280-460 keV$^1$, EVAN SAND, R. FRANCE, Georgia College and State University, S. STAVE, M.W. AHMED, S.S. HENSHAW, H.R. WELLER, Duke & TUNL, R.M. PRIOR, M.C. SPRAKER, North Georgia College and State University — One of the poorly understood reactions that may contribute to heavy element inhomogeneous nucleosynthesis is the $^{13}$C(d,n)$_0$$^{14}$N reaction. To understand the dynamics of this reaction, we have measured the yield and vector analyzing power of the n$_0$ group in the deuteron energy range from 280 keV to 460 keV. Neutrons were produced by a deuterium beam from the atomic beam polarized ion source, accelerated through the TUNL mini tandem onto a thick and enriched $^{13}$C target. Eight organic liquid scintillator neutron detectors were placed at angles from 0° to 150°. Results for the angular distributions of the yield and analyzing power were extracted and will be shown.

$^1$This work was partially supported by the U.S. D.O.E. under grants DE-FG02-97ER41046, DE-FG02-97ER41033, AND DE-FG02-97ER41042.

DA.00088 Fusion reactions using the new and improved focal plane of SASSYER$^1$, A. SCHMIDT, A. HEINZ, R. WINKLER, J. QIAN, Yale University, G. HENNING, Yale University, ENS de Cachan, J.R. TERRY, Yale University, Z. BERANT, Yale University, Nuclear Research Center Negev, M. BUNCE, Yale University, University of Surrey, R.J. CASPERSON, R.F. CASTEN, V. WERNER, E. WILLIAMS, Yale University — The Small Angle Separator System at Yale for Evaporation Residues (SASSYER) is a gas-filled magnetic separator used to transmit recoils from fusion-evaporation reactions to detectors at the focal plane. Improvements to the focal plane of SASSYER, including the addition of a Multi-Wire Avalanche Counter (MACY) as well as two 2400-pixel Double-sided Silicon Strip Detectors (DSSDs) with multiplexed electronics, were completed in the spring of 2008. Recoils can now be identified at the DSSDs by time-correlated alpha decays. The observed alpha decays are then correlated to prompt gamma events detected at the target position. The physics program at SASSYER is aimed at the study of the structure of neutron-deficient trans-lead and actinide nuclei. We present the results of the first experiments performed with the improved focal plane investigating $^{208}$Rn, $^{214}$Ac and $^{216}$Th.

$^1$This work was supported by U.S. DOE Grant No. DE-FG02-91ER-40609.

DA.00089 Discovery of Isotopes, A. SCHUH, Gustavus Adolphus College, A. SHORE, Smith College, A. BURY, A. FRITSCH, J.Q. GINEPRO, M. HEIM, J. SNYDER, M. THOENENNESSER, NSCL/MSU — We started a project to document the discovery of all known isotopes. The information for the isotopes are summarized for each element, including the discoverers, the laboratory and year in which it was first observed, the production method and the method of mass assignment used. Only refereed publications were considered, but unreported publications and other various discrepancies pertaining to the discovery of individual isotopes are also discussed. The project began only recently and we will present the discoveries of the first elements summarized: arsenic, barium, cerium, einsteinium, gold, iron, krypton, silver, and vanadium.

DA.00090 Simulations of $^{12}$C Break Up In A Twin Ionization Chamber$^1$, C.B. SEGAL, Florida State University, N.R. PATEL, U. GREIFE, Colorado School of Mines, K.E. REHM, C.M. DEIBEL, J. GREENE, D. HENDERSON, C.L. JIANG, B.P. KAY, H.Y. LEE, R. PARDO, M. NOTANI, Argonne National Laboratory, S.T. MARLEY, Western Michigan University, X.D. TANG, University of Notre Dame — In stellar explosions the triple alpha decay process is key to forming the life-giving $^{12}$C. This experiment is to further investigate the energy region in $^{12}$C around 10 MeV where a theoretically predicted $^{2}$ state has yet to be observed. The motivation for studying this is to better understand the $^{12}$C nucleosynthesis process that occurs in red giant stars where the short lived $^{8}$Be interacts with alphas at extreme temperature and pressure scenarios which then in turn creates $^{12}$C. We study the particle-unbound states by implanting $^{12}$B into a twin Frisch grid ionization chamber and following the decay into $^{12}$C and subsequently into three alpha particles. The response of this ionization chamber to the detection of multiple alpha particles was studied using various simulation programs. Results of these simulations and limits for the predicted $2^{+}$ state will be presented.

$^1$This work is supported by the U.S. DOE, ONP, under contract DE-AC02-06CH11357 (ANL) and DE-FG02-91ER41033 (WMU). Authors from the Notre Dame acknowledge support from the NSF under grant PHY01-40324, and the JINA, NSF-PFC under grant PHY02-16783.

DA.00091 Track Reconstruction for the NIFFTE TPC, SARVAGYA SHARMA, Abilene Christian University, NEUTRON INDUCED FISSION FRAGMENT TRACKING EXPERIMENT COLLABORATION — The Global Nuclear Energy Partnership (GNEP) has funded the construction of a Time Projection Chamber (TPC) to be used for precision fission cross-section measurements through the Nuclear Energy Research Initiative (NERI). This poster will illustrate the status of algorithms intended for intelligent track finding and track fitting using raw data obtained TPC simulations will be presented. The track fitting effort in this experiment has borrowed a number of ideas from high-energy physics along with other pattern recognition techniques not previously affiliated with experimental physics. Two track-finding techniques have been investigated. The Hough Transform is a brute force method that attaches to a target ladder on which aluminum foils and a slit for beam profile analysis can be mounted. The targets produced will be used in a number of experiments with stable and unstable beams. A detailed update of the project will be presented.

DA.00092 Target Implantation for Inverse $(^3$He,d) Reaction Studies$^1$, D.J. SISSOM, R.L. KOZUB, Tenn. Tech. Univ., D.W. BARDAYAN, D.W. STRACENER, ORNL — Proton transfer reactions such as $(^3$He,d) can provide valuable structure information on proton single particle states and resonances, some of which are very important for the rp process in explosive nucleosynthesis. In stellar explosions, the reactants are often radioactive, so radioactive ion beams and inverse kinematics are needed for such studies. These $(^3$He,d) experiments in inverse kinematics require localized $^3$He targets. Since helium gas jet targets are difficult and expensive to produce, implanted targets may be the more practical solution. Helium implanted Al foil targets have been successfully produced in other facilities up to densities of $\sim 4 \times 10^{17}$ ions/cm$^2$. The UNISOR facility at ORNL can be utilized to implant He ions, but modifications to the UNISOR collection chamber are needed. A new assembly has been designed to accommodate a linear motion feedthrough that attaches to a target ladder on which aluminum foils and a slit for beam profile analysis can be mounted. The targets produced will be used in a number of experiments with stable and unstable beams. A detailed update of the project will be presented.

$^1$Supported by the U.S. Department of Energy.

$^2$J. E. McDonald et al., Journal of Instr. 1, 09003 (2006).
DA.00093 A Geant4 simulation for DSAM lifetime measurements at low recoil velocities\textsuperscript{1}. MALLORY SMITH, Central Connecticut State; WNSL, Yale University, J. RUSSELL TERRY, WNSL, Yale University — Lifetimes of low-spin excited states can be determined by populating such states in light-ion fusion-evaporation reactions. Reduced transition probabilities derived from these measurements provide a sensitive test for low-energy nuclear structure models. The Doppler shift attenuation method (DSAM) is a common, flexible technique used to resolve lifetimes for stable and unstable isotopes on the order of hundreds of femtoseconds. DSAM is typically employed in heavy-ion fusion-evaporation, in which nuclei have high recoil velocities and introduce high angular momenta to the compound system. However, these reactions generally populate high-spin and yrast states. We explore the possibility of using DSAM to extract lifetimes from low-spin, non-yrast states, using light-ion-induced fusion-evaporation, where the nuclear recoil velocity is small. A Geant4 simulation was created to test the viability of using light ions to measure lifetimes. From the simulation, the minimum required bombarding energy was ascertained.

\textsuperscript{1}This work was support by U.S. DOE Grant No. DE-F602-91ER-40609.

DA.00094 Cross-sections of alpha scattering on Boron 11. ANDREW SMITH, Georgia College and State University — There has been a recent renewal in the interest of aneutronic fusion as a power source using the $^{11}$B(p,α)2α reaction. In light of this, TUNL has been requested to measure accurate cross sections for the $^{11}$B(p,α)2α reaction as well as $^{11}$B(α,α). To measure the cross section of $^{11}$B(α,α) the capture group at TUNL has collected data using a target with a 2-3 $\mu$g/cm$^2$ layer of isotopically pure $^{11}$B between two layers of gold. A beam was generated using the TUNL alpha source and accelerated with the tandem accelerator producing beam energies up to 7 MeV. Silicon surface barrier detectors were placed at 45, 60, 75, 90, 90, 110, 130, 150 degrees. There are some discrepancies between the present data and the previous data that have yet to be resolved. Preliminary results as a function of energy and angle will be shown and compared to previous measurements.

DA.00095 Assembling Nine Resistive Plate Chamber Prototype Modules for PHENIX. THALASSA SODRE, Muhlenberg College, PHENIX COLLABORATION — The Pioneering High Energy Nuclear Interaction eXperiment, located at the RHIC ring at Brookhaven National Laboratory, is designed to examine direct probes from proton-proton and heavy ion collisions. One of the goals of PHENIX is to discover how the components of the proton contribute to its intrinsic spin. Specifically, the muon trigger upgrade at PHENIX focuses on flavor separated quark and anti-quark contributions to proton spin. The goal of the upgrade is to enhance our ability to collect and analyze muons that decay from W-bosons produced in polarized proton-proton collisions. To achieve this, Resistive Plate Chambers (RPCs) and new front-end electronics will be employed that will enable us to discern high Pt muons from the low Pt muon background. This poster will focus on the assembly and quality assurance procedures of the RPC modules. Over the summer nine RPC prototypes were assembled and tested on a cosmic ray stand. Two half octants–made up of three RPC prototypes each—will be installed on the south arm of the PHENIX detector this fall.

DA.00096 NIFFTE Overview and Goals. SCOTT STEWART, Abilene Christian University, NEUTRON INDUCED FISSION FRAGMENT TRACKING EXPERIMENT COLLABORATION — The Neutron Induced Fission Fragment Tracking Experiment (NIFFTE) will make fission section measurements for next generation nuclear reactors using a Time Projection Chamber (TPC). Collaborating institutions are Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Idaho National Laboratory, Georgia Institute of Technology, Abilene Christian University, Oregon State University, Cal Poly San Luis Obispo, Colorado School of Mines, and Ohio University. It is funded under the Global Nuclear Energy Partnership (GNEP) in order to increase the precision needed for the design of a new generation of fast neutron reactors. The TPC is a new tool to improve the existing measurements that used fission chambers. TPC will provide an overall view of the fission event and will distinguish it from background processes, primarily alpha decay. The experiments are planned at the Los Alamos Neutron Scattering Center (LANSCE) utilizing neutron beams from 10 keV to 10 MeV where existing fission cross sections have typical uncertainties of 5%.

DA.00097 Testing a luminosity detector for the BRAN project at the LHC. JOHANNES STILLER, LUMI TEAM\textsuperscript{1} — Two pairs of segmented ion chambers, called BRAN, are used at CERN's LHC. One pair is located at the ATLAS interaction region while the other is at CMS. The detector itself is a pressurized gas ionisation chamber. It is segmented into four multi-gap quadrants which are able to function independently. This device will measure the bunch by bunch luminosity and crossing angle of the beam at both locations. Recently, the device was tested at CERN's SPS with 300 GeV protons using its final electronic design. The performance of the BRAN was studied as a function of pressure, absorber thickness, and voltage. We have compared these test results to that of Monte Carlo simulations. These results as well as the current status of this detector will be presented.

\textsuperscript{1}Lawrence Berkeley National Laboratories

DA.00098 Temporal Variation in Cosmic Ray Muon Flux. STEVEN STROBERG, KALYA EVANS, BETHANY LYLES-GOLDBLUM, ERIK SWANBERG, ERIC NORMAN, Nuclear Engineering Dept-University of California, Berkeley — Plastic scintillator detectors are often used in homeland security applications that look for high energy photons, such as active interrogation of cargo containers. In these applications, the background due to cosmic ray muons is assumed to be constant. However, there appears to be potentially significant variation in the muon flux over time. The muon flux was measured over a period of several months using two plastic scintillator detectors [122x61x15 cm and 30x30x10 cm]. The data from these detectors were compared to data from cosmic ray neutron detectors in Kiel, Calgary, Moscow, Thule and Beijing collected during the same time period. The results show that the temporal variation in muons is significantly greater than that of the cosmic ray neutrons.

DA.00099 Quality Control for the RPC Upgrade for PHENIX. DILLON THOMAS, Abilene Christian University, PHENIX COLLABORATION — The PHENIX detector is located at Brookhaven National Laboratory on the Relativistic Heavy Ion Collider (RHIC) where it studies both heavy ion and polarized proton-proton collisions. One of the primary goals of the polarized proton program is to improve our understanding of the proton's spin structure. A level 1 trigger upgrade is currently being constructed for PHENIX. This will involve the installation of Resistive Plate Chambers (RPCs). These new chambers will improve our ability to trigger on high transverse momentum single muons that are produced in the decay of W bosons. After these chambers are constructed, they must be carefully and completely checked to ensure they operate properly, before they are installed in the PHENIX spectrometer. These chambers are assembled as modules and then tested in our cosmic ray test stand while they are hooked up to data acquisition and gas systems. From cosmic ray muons, we can carry out tests to learn the efficiency and performance of each RPC. These tests ensure that only fully efficient chambers will be used in the final installation in the PHENIX spectrometer. Data and graphs of the efficiencies and performance will be presented.

DA.00100 Simulation of NIFFTE TPC. REMINGTON THORNTON, Abilene Christian University, NEUTRON INDUCED FISSION FRAGMENT TRACKING EXPERIMENT COLLABORATION — The Global Nuclear Energy Partnership (GNEP) has funded the construction of a Time Projection Chamber (TPC) to be used for precision fission cross-section measurements through the Nuclear Energy Research Initiative (NERI). One important requirement of the TPC project is to have an accurate simulation of the physical volume and realistic data flow. GENAT4 is multi-purpose 3-D Monte Carlo simulation package that has been chosen for this effort. The sensitive volume of the TPC has been created in GENAT4 along with simulation of the detector response, which includes: 3-D ion diffusion, pedestal fluctuations, charge sharing and digital latching noise. In this poster, results from the initial simulation will be described in detail.
DA.00101 Systematic Trends in Nuclear Reactions, LUKE TITUS, University of Wisconsin River Falls — A systematic study of elastic scattering is performed to test global optical potentials. Many global optical potentials exist in the literature. Here, three popular potentials were used to predict cross sections of proton elastic scattering: Perery and Perery, Chapel Hill and Koning and De la Roche. The predicted cross sections are compared with experimental data for accuracy. In addition to the elastic studies, transfer (d,p) reactions are also calculated using the adiabatic method to construct the deuteron optical potential. Two methods for constructing the deuteron optical potentials are tested for accuracy, the first consisting on the Johnson and Soper approximation and the second on the finite-range correction by Wales and Johnson. Systematic trends in the predicted cross sections are analyzed as neutrons are added to the target and projectile energies are changed. Our calculations have shown that some well established potentials may lose their predictive power over certain mass and energy ranges, while others are more consistent.

DA.00102 Design of an in-beam gamma coincidence measurement to study K-forbidden transitions in $^{178}$Hf induced by bremsstrahlung1, GEOFFREY TREES, JAMES CARROLL, Youngstown State University — Recent experiments [1] have suggested that several K-forbidden transitions exist that feed the 31-year isomer $^{178m}$Hf from the ground state band, with surprisingly large transition probabilities. Further study is needed, however, to confirm this result and to more accurately measure the probabilities. One approach would be to excite these transitions using real photons (bremsstrahlung) incident on an isomeric target, and to search for resulting emission of gamma emission within the ground-state band that do not occur during natural decay of the isomer. This poster will describe an experiment in development to investigate one of the reported K-forbidden transitions, at 331 keV, by in-beam coincidence gamma spectroscopy using two Ge clover detectors.

1Supported by DTRA

DA.00103 The Effects of Measurement Errors on Neutrino Angular Resolution in the IceCube Neutrino Detector, LESLIE UPTON, Hampton University, ICECUBE COLLABORATION — The IceCube collaboration is actively pursuing neutrino detection to study astrophysical sources. These neutrinos are identified by the secondary muons detected within the IceCube detector array. The muon track is reconstructed using the information provided by the time information of Cherenkov photon illuminated digital optical modules (DOMs) within the detector. However, it is imperative to calculate how different measurement errors affect the reconstruction of the muon. A Monte Carlo simulation was developed in order to study these effects on the resolution of the muon reconstruction. The simulation, developed in ROOT, creates a muon in an array detector and uses time information from illuminated DOMs and Minuit to reconstruct the parameters of the muon without any knowledge of the original coordinates of the muon. Minuit provides precise results, with spikes around zero for the space angle between the original and reconstructed muon tracks. There are correlations between the number of illuminated DOMs, muon track length, and the angular resolution of the reconstructed track. Further work includes exploring photon statistics, energy dependence and more precise DOM information.

DA.00104 Using a Geant4 Simulation to Model E906, MARISSA WALKER, Abilene Christian University, E906 FERMILAB COLLABORATION — The goal of E906 at FNAL is to further explore the anti-quark distribution in the nucleon sea using a 120 GeV proton beam and fixed liquid hydrogen and deuterium targets. The resulting particles pass through a spectrometer of two magnets, three stages of scintillator and wire chambers, and layers of absorber designed to absorb and deflect as much of the background noise as possible, isolating pairs of muons produced by the Drell-Yan process. The design of the first magnet previously involved an open aperture with a number of layers of hadron absorbers inserted. However, in order to reduce cost, the plan is now to have a solid iron magnet. Geant4 based simulations were used to determine if this magnet would be able to especially in minimize background rates adequately. Based on simulation results, the solid iron magnet should be sufficient. Various possibilities for the geometry of this magnet, as well as the layout of the target and absorbers, have been evaluated.

DA.00105 Investigation of extensions to the Glauber model of nuclear collisions, RYAN WARD, California Polytechnic State University, San Luis Obispo, J.L. KLAY, California Polytechnic State University — The Glauber model of nuclear collisions describes the geometrical distribution of interacting nucleons. Monte Carlo versions of the Glauber model have been very successfully applied to data from the Relativistic Heavy Ion Collider. This poster will describe how it is used to model the collisions of nuclei at high energy particle accelerators such as RHIC and the LHC, as well as possible quark level extensions to the model. A computer simulation of the model written in Java with full visualization and outputs to ROOT will be demonstrated.

DA.00106 $B_s^0$ Meson Reconstruction Through the $J/\psi$ Decay Channel with the Heavy Flavor Tracker at STAR, JOSHUA WEINER, California Institute of Technology, STAR COLLABORATION — The Solenoidal Tracker at RHIC (STAR) is an ongoing experiment at the Relativistic Heavy Ion Collider (RHIC) located at Brookhaven National Laboratory. Its goals are to observe and study the characteristics of the quark-gluon plasma produced by nuclear collisions. The Heavy Flavor Tracker (HFT) is a new high-resolution vertex detector that has been proposed by STAR. The HFT will allow high-resolution tracking of charged particles, enabling the identification of particles containing charm and bottom quarks that decay hundreds of microns from the primary interaction vertex. The $B_s^0 \rightarrow J/\psi \ X$ and $J/\psi \rightarrow e^+ e^-$ decay channels form a good candidate for $B_s^0$ meson detection due to the presence of the dielectron pair generated at a large distance from the primary vertex. Reconstruction of $B_s^0$ events mixed with Au-Au 200 GeV events was performed with the STAR software library. We will show how the HFT can identify the $B_s^0$ events and what can be learned by identifying the B mesons.

DA.00107 Silicon Detector Deadlayer Measurements1, MEAGAN WHITE, KATE JONES, RYAN KAPLER, BRIAN MOAZEN, KYLE SCHMITT, University of Tennessee at Knoxville — The Oak Ridge Rutgers Universities Barrel Array (ORRUBA) is a large silicon detector array for measuring ejectiles from transfer reactions [ref]. A large component of ORRUBA is made up of position sensitive silicon strip detectors which use a resistive readout to give position information. The ejectile energy is found by summing the signals on the two ends. This method assumes that the complete energy of the particle is recorded. However, before the particle reaches the active part of the detector, there is a thin layer in which the particle loses energy before it is detected. This layer of the detector is the deadlayer, and to get an accurate ejectile energy for the particle, the energy lost in the deadlayer prior to detection has to be known. We have developed a technique to measure the thickness of the deadlayer using an alpha source and rotating the detector. I will present this technique and the results we have obtained with it.

1This work was supported in part by The University of Tennessee at Knoxville Department of Physics and Astronomy.
DA.00108 Effects of Two-Nucleon Correlations in the Formation of Multiquark Clusters in Nuclei . PAUL W. WIECKI, DREW A. FUSTIN, Drake University, JAMES P. VARY, Iowa State University, ATHANASIOS N. PETRIDIS, Drake University — If the wavefunctions of two or more 3-valence-quark nucleons bound in a nucleus overlap sufficiently, quark clusters made of 6, 9 or more valence quarks may be created. The quark cluster probabilities depend on the single-body nuclear densities and correlations. The radial single-particle nuclear density is approximately calculated analytically, using a harmonic oscillator mean potential with spin-orbit coupling, or, more accurately, by numerically diagonalizing the Hamiltonian with potentials, such as Woods-Saxon, in the Independent Particle Model. These theoretical results are compared to scattering data to isolate the two-body nuclear correlations. The resulting single-particle density and two-nucleon correlation function are incorporated into a quasi-classical Monte-Carlo algorithm, using network theory, which calculates the multi-quark cluster formation probability for several nuclei. The parton momentum distributions in quark clusters differ from those in single nucleons. The calculated cumulative cluster probabilities together with appropriate parton distributions are sufficient to describe the EMC effect for all Bjorken-$x$, dilepton production off nuclei, and $J/\Psi$ suppression.

DA.00109 Simulations of a HELIOS Recoil Detector , JACK WINKELBAUER, Western Michigan University, HELIOS COLLABORATION — The Helical Orbit Spectrometer (HELIOS) is a new type of light-charged particle spectrometer, designed to study inverse kinematic nuclear reactions with unstable beams. HELIOS is based around a 3T superconducting solenoid with the magnetic axis aligned with the beam axis. The ejected light nuclei undergo helical motion, transporting them from the target to a hollow array of silicon detectors. The heavy recoil nuclei scatter at small angles in the forward direction. HELIOS will require heavy recoil detection. Possibilities for recoil detection include an ionization chamber or an annular silicon detector. A full three dimensional field map has been measured and incorporated into the existing Monte Carlo simulations. These simulations have been used to investigate the transport properties of the HELIOS spectrometer for the heavy recoil nuclei. The acceptance of these recoil detection methods, as well as details on the placement and operation of a HELIOS recoil detector will be presented. Work supported by the U. S. Department of Energy, Office of Nuclear Physics under grant numbers DE-FG02-04ER41320 and DE-AC02-06CH11357.

DA.00110 Calculating dilepton production from pions interacting with a disoriented chiral condensate , SHAWN WITHERAM, Texas A&M University Cyclotron REU — Recent data by the PHENIX collaboration at RHIC show an enhancement of low invariant-mass dilepton production in Au-Au collisions at 200 GeV [1]. In this project we study whether the formation of a Disoriented Chiral Condensate (DCC) could explain (part of) this dilepton enhancement. In particular, we compute dilepton production by means of annihilation of DCC domains [2], and compare it to baseline calculations where two thermal pions are annihilating via a rho meson. Using an in-vacuum rho meson line shape, the DCC-DCC annihilation is the dominant source at very low mass ranges. However, it is shown that using an in-medium rho meson [3] the thermal pion-pion annihilation drowns out the effects of the DCC-DCC annihilation. The calculation of dilepton production from thermal pions interacting with a DCC will also be looked at in continued work. [1] PHENIX Collaboration, “Enhancement of the dielectron continuum in Au-Au collisions at $\sqrt{s_{NN}}=200$ GeV,” arXiv:0706.3034v1 (2007).

DA.00111 TPC Pad Structure and Track Reconstruction for the Muon Capture on Deuterium , LUKASZ WOJTAGSZEK, University of Illinois at Urbana-Champaign, MUSUN COLLABORATION — The MuSun experiment proposes to measure the rate $\lambda_D$ for the muon capture on the deuteron to better than 1.5% precision. The measurement will provide the low-energy constant representing the coupling of the axial current to the two-nucleon system necessary in describing weak interaction processes in two-nucleon systems such as solar pp fusion and $\nu + d \rightarrow \pi + p$ reactions observed by the Sudbury Neutrino Observatory. The desired precision requires a cryogenic Time Projection Chamber (TPC) to be designed and built. A Monte Carlo simulation of muon tracks was used to determine the optimal geometry and size of the TPC pads, taking into account noise and crosstalk. A track reconstruction program was developed to determine the three dimensional path of the muon to within a fraction of the pad size. The drift time of the electrons gives the height above the pad. The energy deposited on the TPC pads, following the Bragg curve, allows determination of the muon stopping position to within a fraction of the pad size. The information will be combined to reconstruct the three dimensional path of the muon in the chamber. Progress on this project will be reported.

DA.00112 Neutron Pulse Shape Discrimination in Long Liquid Scintillator Counters , BRADLEY WOOD, JEFF BLACKMON, SAWARNIK DIIXIT, LAURA LINHARDT, EDWARD ZGANJAR, Louisiana State University — Efficient and selective neutron detection is important for nuclear physics research and for applied areas like homeland security. Counters based upon some varieties of liquid scintillator have the significant advantage that neutrons can be discriminated based upon pulse shape analysis. Large counters are desired to achieve high efficiency, but the effectiveness of pulse shape discrimination is compromised in some large geometries by light propagation and reflections that distort the signal shape. We are studying signal distortion in long (lengths up to 2 m) counters based upon the EJ301 scintillator. Digital signal processing and waveform analysis are being applied in an effort to improve neutron discrimination despite signal distortion. The approach and preliminary results will be presented.

DA.00113 Testing Different Materials to Produce Gas Gaps in High Rate RPCs , RYAN WRIGHT, Abilene Christian University, FOR THE PHENIX COLLABORATION — The PHENIX experiment at the Relativistic Heavy Ion Collider at Brookhaven National Laboratory uses polarized proton-proton collisions to study the spin of the proton. This study is made by reconstructing muons produced in the proton collisions. As RHIC moves to higher energies, the existing trigger is not sufficient to select the events of interest such as single high $p_T$ muons that are a result of W-Boson production. To aid the current muon triggering system, fast Resistive Plate Chambers made from Italian Bakelite are being added to the detector system. At the University of Illinois Urbana-Champaign, a test stand has been built to help understand different factors that affect the RPCs performance and rate capabilities. The test stand uses open gas gap RPCs which are ideal for testing different materials and their rate capabilities of these different materials. Various materials and their placement and operation of a HELIOS recoil detector will be presented. Work supported by the U. S. Department of Energy, Office of Nuclear Physics under grant numbers DE-FG02-04ER41320 and DE-AC02-06CH11357.

DA.00114 Testing and classification of various silicon detectors , KENNETH WUNDER, TAMU Cyclotron Institute — In order to truly understand the techniques used in nuclear physics experiments and radiation detection, it becomes necessary to explore the basic interactions between the energy quanta and the detector itself, the way in which the detector signals and captures this energy, the methods of electronic signal processing, and, finally, the analysis of the data recorded during the testing. The testing explored three different types of silicon detectors, focusing on the most often used categories for classification and the tests used to get the results.

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1 application for the CEU in Oakland, CA

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1 RET Group at the Cyclotron Institute, TAMU
DA.00115 Static Magnetic and Quadrupole Moments of Excited States of Nuclei³, SEAN YEAGER, LARRY ZAMICK, YITZHAK SHARON, Rutgers University — The gyromagnetic ratio (g) is the ratio of μ to J. We have noticed that many isoscalar g factors of excited states in both even-even and odd-odd nuclei have values close to 0.5 nuclear magnetons. It should be noted that both the collective model and the single j shell model (in the limit of large orbital angular momentum l) predict this result. We also note the importance of the “j forbidden” [γ^2 σ] term for magnetic moments. For quadrupole moments we define the quadrupole ratio, Q/2M, i.e. the ratio between the intrinsic quadrupole moment deduced from 2^+ states and from B(2E2). Ideally, the rotational model predicts a value of one for the quadrupole ratio while the simple vibrational model predicts zero. The poster will show a graph plotting this ratio against mass number. There are small regions where the ratio is close to zero and larger regions where the ratio is close to two. Also, there are intermediate regions which lie in between these two limits. This theoretical analysis is of relevance to the experimental program of Prof. Noemie Koller at Rutgers University.

³Support from the Aresty Program at Rutgers is gratefully acknowledged.

DA.00116 Simulation of Bottom Measurement with the STAR HFT Detector, XIAOYU ZHU, UCLA, STAR COLLABORATION — STAR (Soloidal Tracker At RHIC) is a working experiment at RHIC (Relativistic Heavy Ion Collider) to study properties of Quark-Gluon Matter under extreme energy density and temperature. Bottom quark production and propagation is a unique probe of the dense matter created at RHIC. The HFT (Heavy Flavor Tracker) is a proposed detector upgrade of STAR, capable of reconstructing open charm/bottom hadrons at midrapidity. We present a study of B meson reconstruction via the semi-electronic channel using GEANT simulations of HFT performance. We carried out two approaches to separate B from D mesons: the impact parameter method and the displaced vertex method. First, B mesons have mean proper decay lengths of 500 microns, so their decay electrons have large impact parameters with respect to the interaction vertex. Second, the secondary vertex (daughter D decay) displacement is in the direction of the B meson, and close to the direction of the decay electron, so the flight distance (the scalar product of the secondary vertex displacement and the daughter electron momentum) provides a good measure for the B meson reconstruction. Preliminary results on STAR HFT B measurement performance will be discussed.

Friday, October 24, 2008 4:00PM - 5:48PM –
Session EA Nucleon Spin Structure and Its Spin-Offs Simmons Ballroom 2-3

4:00PM EA.00001 Spin Structure of the Nucleon: An Overview¹, FENG YUAN, Lawrence Berkeley National Lab/RIKEN-BNL Center — In this talk, I will review the current status of nucleon spin physics, and the future perspective.

¹This work was supported in part by the U.S. Department of Energy under contract DE-AC02-05CH11231. We are grateful to RIKEN, Brookhaven National Laboratory and the U.S. Department of Energy (contract number DE-AC02-98CH10886).

4:36PM EA.00002 The nucleon spin structure at short distance, RALF SEIDL, RBRC — The spin structure of the nucleon has been the basis of several surprises in the past. After the EMC experiment showed that the quark spin contribution to the nucleon spin was small, several experiments were performed to further investigate this "spin crisis." Deep inelastic scattering (DIS) experiments at CERN, SLAC, and DESY successfully confirmed the low quark spin contribution to the nucleon. Using semi-inclusive DIS, SMC, HERMES and COMPASS were also able to obtain flavor separated quark polarizations. DIS experiments are only sensitive to gluon polarization at NLO via the QCD evolution of the structure function g_1, or through di-jet/hadron production in photon-gluon fusion processes. Proton-proton collisions are sensitive to the gluon polarization at leading order. The RHIC experiments PHENIX and STAR have measured inclusive pion and jet asymmetries which exclude huge gluon polarizations but a substantial contribution to the spin of the nucleon is still possible. Another aspect of spin measurements are transverse spin phenomena. Once deemed to be vanishing in perturbative QCD recent nonzero transverse single spin asymmetries observed at RHIC and HERMES could be explained in the framework of transverse momentum dependent (TMD) distribution and fragmentation functions. One is the so-called Sivers function which requires a nonzero parton angular momentum. Early global analyses were able to combine the data obtained at RHIC, COMPASS and HERMES. Another TMD function is the Collins fragmentation function, first measured at BELLE, which serves as a transverse spin analyzer to extract the quark transverse spin distribution from the SIDIS experiments. Also here a first global analysis of SIDIS and BELLE data has been successfully performed. An overview on recent spin related measurements at short distance, performed at PHENIX, STAR, BRAHMS, HERMES, COMPASS and Belle will be given.

5:12PM EA.00003 Results on the Moments of the Spin Structure Functions: Sum Rules and Polarizabilities, JIAN-PING CHEN, Jefferson Lab — Based on general physics principles, sum rules relate integrations of the structure functions to static properties, or, in the generalized situation, to the forward Compton amplitudes. Sum rules provide a powerful way to study nucleon structure and the strong interaction. Nucleon spin structure functions g_1 and g_2 have been measured over a wide range of kinematics. Moments of the spin structure functions were extracted from very low to medium range of Q^2 to study the spin sum rules and the spin polarizabilities. The results were compared with calculations, in particular, at low Q^2, with Chiral Perturbation Theory calculations. Discussions and perspectives will be presented.

Friday, October 24, 2008 4:00PM - 5:48PM –
Session EB Nuclear Theory: Few-Body Room 208

4:00PM EB.00001 Separable Expansions of V_{low} for 2- and 3-Nucleon Systems, JAMES SHEPARD, University of Colorado, Boulder, JAMES MCNEIL, Colorado School of Mines — We present an alternative organizational scheme for developing effective theories of 2- and 3-body systems that is systematic, accurate, and efficient with controlled errors. To illustrate our approach we consider the bound state and scattering properties of the ^3S_1 and ^4S_3/2 2- and 3-nucleon systems. Our approach combines the computational benefits of using separable potentials with the improved convergence properties of potentials evolved with a renormalization group procedure. Long ago Harms showed that any potential can be expanded in a series of separable terms, but this fact is only useful if the expansion can be truncated at low order. The separable expansion provides an attractive organizational scheme that incorporates finite range effects at the outset in contrast to the familiar effective range theory starting with contact interactions. We show that when applied to a renormalization group-evolved potential, the separable expansion converges rapidly, with accurate results for both 2- and 3-body scattering processes using only two separable terms.
4:12PM EB.00002 Chiral three-nucleon forces at N3LO, RUPRECHT MACHLEIDT, University of Idaho — In recent years, there has been substantial progress in the derivation of nuclear forces from chiral effective field theory. Accurate two-nucleon forces (2NF) have been constructed up to next-to-next-to-next-to-leading order (N3LO) and applied with a fair amount of success. However, chiral three-nucleon forces (3NF) have been used only at N2LO, improving some microscopic predictions, but leaving also several issues, like the “A_y puzzle”, unresolved. Thus, the 3NF at N3LO is needed for essentially two reasons: for consistency with the 2NF and to (hopefully) improve some critical predictions. I will summarize the current status of the derivation of the 3NF at N3LO and discuss the expectations of their impact on ab initio calculations.

4:24PM EB.00003 ABSTRACT WITHDRAWN —

4:36PM EB.00004 Faddeev and Glauber Calculations at Intermediate Energies in a Model for n-d Scattering1, CH. ELSTER, T. LIN, Ohio University, W. GLOECKLE, U. Bochum, S. JESCHONNEK, Ohio State University — Faddeev calculations of three-body scattering in the intermediate energy regime are carried out in a model for n-d scattering. In order to go to higher energies, the Faddeev equation is formulated and directly solved without employing a partial wave decomposition, leading to a three-dimensional integral equation in five variables, from which the cross sections for elastic and breakup scattering as well as differential cross sections are obtained. These same observables are calculated based on the Glauber formulation. The first order Glauber calculation and the Glauber rescattering corrections are compared in detail with the corresponding terms in the Faddeev multiple scattering series for projectile energies between 100 MeV and 2 GeV.

1supported by U.S. DOE, NSF, OSC

4:48PM EB.00005 The Transverse Electron Scattering Response Function of 3He, EDWARD TOMUSIARK, University of Victoria, SARA DELLA MONACA, Universita di Trento, VICTOR EFRÖS, Kurchatov Institute, AVAS KHUGAEV, Uzbekistan Academy of Sciences, WINFRID LEIDEMANN, GIUSEPPINA ORLANDINI, LUPING YUAN, Universita di Trento — The Transverse electron scattering response function $R_1(q, q')$ is calculated using the Bonn-RA nucleon-nucleon (NN) potential, the TM$^*$$^*$ three-body force and the Coulomb potential. Complete final state interactions are taken into account via the Lorentz integral transform technique. The electromagnetic interactions include meson exchange currents plus the usual one-body terms. Since the transverse response is driven by nuclear currents it is important to verify that charge conservation is maintained. A measure of this is obtained from a comparison of the response calculated using i) a Siegert form of the transition operator and additional contributions beyond it and ii) an operator expressed totally in terms of currents. Charge conservation requires i) and ii) give identical results. We show that with a simple OBEP NN-interaction with $\pi$- and $\rho$-exchange and its corresponding meson exchange currents the results are indeed the same. The main goal is in fact to study the contributions of meson exchange currents beyond the Siegert operator for various kinematical configurations. Theoretical results will be compared with experimental data in quasi-elastic kinematics at $q=250,400,500$ MeV/c and in the threshold region at $q=174$ MeV/c.

5:00PM EB.00006 Electromagnetic two-body currents of one- and two- pion range, SAORI PASTORE, Department of Physics, Old Dominion University, Norfolk, VA 23529, JOSE GOIITY, Department of Physics, Hampton University, Hampton, VA 23668 - Jefferson Lab, Newport News, VA 23606, ROCCO SIAVALLA, Department of Physics, Old Dominion University, Norfolk, VA 23529 - Jefferson Lab, Newport News, VA 23606. — The nuclear transverse magnetic two-body current operator is calculated up to next-to-next-to-leading order in chiral perturbation theory. A number of low-energy electronuclear observables including $n\gamma$ capture cross section and the deuterium magnetic moment and isoscalar and isovector magnetic moments of $^3$He and $^3$H are calculated. The matrix elements are evaluated using nuclear wave functions obtained from realistic Hamiltonians involving the Argonne $v_{18}$ and CD Bonn two-nucleon and the Urbana IX three-nucleon interactions.

1The support of the U.S. Department of Energy, Office of Nuclear Physics, under contract DE-AC05-06OR23177, is gratefully acknowledged.

5:12PM EB.00007 Webb Model of Nuclear Structure and Forces, BILL WEBB, Webb Model Scientific — String theory has established that neutrons and protons consist of threesomes of string-like quarks. These threesomes nucleosynthesize to build larger nuclei. This Webb Model differs by postulating that the larger nuclei are also threesomes: threesomes of string-like ring shaped Jumbo Quarks. A threesome of Jumbo Quarks make up every larger nucleus. From this starting point, the Webb Model uses only the forces of gravity and electromagnetics to accurately calculate a large variety of nuclear properties including - fundamental structural shapes and charge arrangements - the size, shape, internal forces and relativistic mass energies of the neutron, proton, deuteron, triton, alpha particle and oxygen - the details of all types of beta decay - the correct slope of the lower end of the nuclear chart - the calculated stability of the 45 smallest stable nuclei and their 59 naturally occurring unstable isotopes - and mathematical confirmation of the magic number 2, 8 and 20. This Webb Model satisfies the empirical tests of the Scientific Method. The mathematics is simple enough to be confirmed by any scientist without bias.

5:24PM EB.00008 On the Convergence of Finite Range Expansions in 3-nucleon Systems, JAMES SHEPARD, University of Colorado, Boulder, JAMES MCNEIL, Colorado School of Mines — We examine the convergence properties of the Effective Range Expansion based on Effective Theories (ET-ERE) of the 2-nucleon scattering amplitude in 3-nucleon applications in the context of a simple rank-1 separable 2-body potential where the finite range effects can be tracked explicitly. To illustrate the approach in a simple context we consider the bound and scattering properties of the $^{1}\Sigma_1$ and $^{3}\Sigma_1 2$- and 3-nucleon systems. We find that the poor convergence of the 3-nucleon scattering amplitude using the ET-ERE can be traced to its poor account of finite range effects that soften the momentum dependence of the deuteron propagator in the Faddeev kernel. In contrast, a simple separable potential with dipole form factors works remarkably well and forms the leading term of a systematic controlled approximation expansion.

5:36PM EB.00009 Classical Solution for Low Energy Nuclear Reactions w/o Tunneleing, STEWART BREKKE1, Northeastern Illinois University(former student) — Low energy nuclear reactions can be explained classically w/o tunneling using nuclear vibration. This equation also explains the proton proton reaction on the sun classically w/o tunneling. An incoming positive charge approaches a vibrating nucleus. If the amplitudes of vibration are equal in all directions, the position of the particle is $r = [(x + A cosX)^2 + (y + A cosY)^2 + (z + A cosZ)^2]^{1/2}$, then $KE = kQ Q^2/r$. If the nuclear reaction takes place contacting the nuclear surface, $x=$AcosX, $y=$AcosY and $z=$AcosZ. Substituting and collecting terms with angle $X=\gamma=\gamma$, $r = A(12cos^2X)^{1/2}$. If cos(max) = 1 or $r = 2A(3)^{1/2}$ with RMS$cos = (1/2)^{1/2} = A(6)^{1/2}$ and if cos(min) = 0 or $r = 0$. Therefore, the nuclear barrier height is a variable dependent upon the amplitude of vibration of the target nucleus with KE needed $= kQ Q^2/2A(3)^{1/2}$ minimum, KE needed $= infinite$, maximum and average KE needed $= kQ Q^2/2A(6)^{1/2}$.

1previous paper presented in DNP06

Friday, October 24, 2008 4:00PM - 5:48PM —
Session EC Mini-Symposium: Neutrino Properties and Nuclear Physics II Jewett Ballroom A-B
4:00PM EC.00001 Perturbative Corrections to the Shell Model Operator for Neutrinoless Double-Beta Decay  
JONATHAN ENGEL, University of North Carolina, GAUTE HAGEN, Physics Division, Oak Ridge National Laboratory — We use many-body perturbation theory to correct the bare double-beta decay operator for configurations that are outside the shell-model space. We sum high-energy ladder diagrams to all orders in the nuclear potential and also evaluate low-energy ladders, core-polarization, and 4-particle 2-hole graphs to first order in the G-matrix. Though the individual graphs can change the bare shell-model matrix element significantly in $^{122}$Se, the sum of all graphs produces only a relatively modest increase.

4:12PM EC.00002 Status of the EXO-200 double beta decay experiment  
DEREK MACKAY, University of Maryland, EXO COLLABORATION — The EXO collaboration is presently constructing and commissioning the world’s largest search for neutrinoless double beta decay. The centerpiece of this experiment, known as EXO-200, is 200 kilograms of xenon enriched to 80% in Xenon-136. The xenon is cooled to 170 K, where it liquefies, and is held in a thin copper vessel inside several layers of radioactive shielding. Ionizing events in the liquid xenon produce a charge signal which we observe on a segmented anode and a scintillation signal which is collected by array of avalanche photodiodes (APDs). The detector measures the three-dimensional event location and the energy of the individual charge deposits, and it can distinguish between multi-site Compton scattering events and single-site signal candidates. The experiment is located underground at the WIPP facility in Carlsbad, New Mexico, and is currently undergoing final commissioning in preparation for physics data taking. We will present in this talk the current status of our preparations and our expected neutrino mass sensitivity.

4:24PM EC.00003 CUORE-0: The First CUORE Tower  
ADAM BRYANT, University of California, Berkeley, and Lawrence Berkeley National Lab, CUORE COLLABORATION — The CUORE experiment will search for neutrinoless double beta decay of 130Te using TeO2 bolometers arranged in 19 closely packed towers. Before construction of the full CUORE detector, the first CUORE tower, named CUORE-0, is planned to be installed in the cryostat that housed the recently completed CUORICINO experiment. The CUORE-0 experiment will test the detector assembly procedures developed for CUORE. It will also improve on the limit on the neutrinoless double beta decay half-life of 130Te set by CUORICINO. The status of CUORE-0 and expectations for its performance will be presented.

4:36PM EC.00004 The Majorana Neutrinoless Double-Beta Decay Experiment  
JAMES FAST, Pacific Northwest National Lab, MAJORANA COLLABORATION — The Majorana collaboration is to study neutrinoless double beta decay $\beta\beta_0$ with an effective Majorana neutrino mass sensitivity near 100 meV in order to characterize the Majorana or Dirac nature of the neutrino, the Majorana mass spectrum, and the absolute mass scale. The Majorana experiment will consist of a large mass of $^{76}$Ge in the form of high-resolution intrinsic germanium detectors located deep underground within a ultra-low-background shielding environment. The experiment will use a phased deployment approach with a final mass target of 1 tonne. The first phase, the Majorana Demonstrator, will deploy 60-kg of germanium detectors with the dual goals of demonstrating background levels suitable for a tonne-scale experiment and testing the Klapdor-Kleingrothaus result (Modern Physics Letters A, Vol. 21, No. 20 (2006) 1547-1556). An overview and status update of the Majorana experiment will be presented in this talk.

4:48PM EC.00005 Search for the double electron capture and electron capture/β decay of $^{120}$Te  
NICHOLAS SCIELZO, Lawrence Livermore National Laboratory, CUORICINO AND CUORE COLLABORATION — Te-120 is a rare, naturally-occurring isotope that can undergo double electron capture and electron capture/β decay with a Q-value of 1700±10 keV. We have analyzed data from CUORICINO to place the most stringent limits on these decay modes. CUORICINO is an array of 62 bolometers comprised primarily of $^{40}$TeO2 crystals and contains 27 g of $^{120}$Te (natural abundance 0.1%). The search for neutrinoless decay modes is currently complicated by a large uncertainty in the decay Q-value. We will present the status of this analysis and prospects for future improvements that will come from data to be collected with the 1-ton TeO2 bolometer array CUORE and a Q-value measurement with sub-keV precision. Lawrence Livermore National Laboratory is operated by Lawrence Livermore National Security, LLC, for the U.S. Department of Energy, National Nuclear Security Administration under Contract DE-AC52-07NA27344.

5:00PM EC.00006 Electron-capture Branch of $^{100}$Tc  
SKY SJUE, ALEJANDRO GARCIA, University of Washington, IRSHAD AHMAD, Argonne National Lab, DAN MELCÔNIAN, Texas A&M University, TOMMI ERONEN, IAIN MOORE, HEIKKI PENTTILA, JUHA AYSTO, University of Jyväskylä, JYFLTRAP COLLABORATION — We present a measurement of the electron-capture branch of $^{100}$Tc performed at the JYFLTRAP facility in Jyväskylä, Finland. The electron-capture branch of $^{100}$Tc determines the solar neutrino absorption cross section of $^{100}$Mo and provides an important test of nuclear-structure calculations for double-beta decay. We discuss implications of this result for theoretical double-beta decay rates from $^{100}$Mo to the ground and excited states of $^{100}$Ru.

5:12PM EC.00007 SNO+ Multipurpose Neutrino Detector  
CHRISTINE KRAUS, SNO+ COLLABORATION — SNO+ proposes to fill the existing SNO detector with liquid scintillator. The unique location in SNOLAB, currently the world’s deepest international underground facility, will enable a variety of physics measurements from further studies of solar neutrinos (pep and CNO), to geo- and reactor neutrinos, to supernova neutrinos to the possibility of studying neutrinoless double beta decay. With the addition of $^{150}$Nd to the liquid scintillator SNO+ is capable of a competitive next-generation search for this rare process. The physics potential and experimental sensitivities will be discussed.

5:24PM EC.00008 Measuring the low energy solar neutrino spectrum with the LENS experiment  
REX TAYLOR, Indiana University, LENS COLLABORATION — The Low-Energy Neutrino Spectroscopy (LENS) experiment is designed for a precision measurement in real time of the fluxes of low energy solar neutrinos (pp, $^7$Be, pep, and CNO, comprising > 99% of the solar neutrino energy) via charged-current capture on Indium-115 (with threshold of 114 keV). LENS will allow a comparison of the neutrino and photon luminosities of the sun that will test the basic assumptions of solar astrophysics and the overall validity of the MSW-LMA neutrino model. The individual flux results will improve limits on $\theta_{13}$ and the pp spectrum can directly probe the temperature profile of fusion energy production. A detector technology, utilizing a novel optical segmentation method with indium-loaded liquid scintillator has been developed. A modest 1 m$^3$ prototype (miniLENS), in development for installation in the Kimballton Underground Research Facility (KURF), will demonstrate experimental feasibility and will allow for optimization for a 200 ton, full-scale LENS experiment.

5:36PM EC.00009 The Daya Bay Experiment: Overview and Timeline  
DAN DWYER, Caltech, DAYA BAY COLLABORATION — The Daya Bay experiment has the greatest sensitivity to sin$^2 2\theta_{13}$ of all experiments currently under construction. Our goal is to either determine the size of this mixing angle, or to establish a limit of sin$^2 2\theta_{13} < 0.01$. Essential aspects include an extremely high power reactor facility, four pairs of “identical” detectors to monitor flux near and far from the reactor cores, strong control of backgrounds, and an aggressive and redundant calibration system. We will describe the main components of the experiment, and present an up-to-date timeline for construction, data taking, and completion.

Friday, October 24, 2008 4:00PM - 5:48PM –  
Session ED Mini-Symposium: Rare Isotope Science III  
Jewett Ballroom G-H
4:00PM ED.00001 Challenges and new opportunities in the study of neutron-rich isotopes1. GUY SAVARD, Argonne National Laboratory — Neutron-rich isotopes are the new frontier for RIB studies. The large neutron excess and reduced importance of the Coulomb barrier allow for exotic phenomena such as halos and skins and an expected modification of the effective interaction and shell-structure far from stability. Important features of these isotopes that can now be studied with existing RIB facilities will be presented. Remaining challenges will be highlighted and future prospects introduced, with a special emphasis on the CARIBU upgrade that will soon make available neutron-rich isotopes from 252Cf fission reaccelerated at energies above the Coulomb barrier.

1This work was supported by the US Department of Energy, Office of Nuclear Physics, under contract no DE-AC02-06CH11357.

4:36PM ED.00002 β decay of 51,52Ar P.F. MANTICA1, H.L. CRAWFORD, J. PEREIRA, J.S. PINTER, J.B. STOKER, NSCL/MSU, R. BRODA, B. FORMAL, IFJ PAN/Krakow, R.V.F. JANSSENS, X. WANG, S. ZHU, ANL, N. HOTELING, W.B. WALTERS, Maryland, C.R. HOFFMAN, S.L. TABOR, FSU — The neutron-rich 51,52Ar isotopes were produced by fragmentation of a 76Ge primary beam of energy 130 MeV/α at NSCL. The A1900 fragment separator, with a wedge degraded and plastic scintillator placed at its intermediate image, was used to select the Ar isotopes of interest from other reaction products. The full 5% momentum acceptance of the A1900 was used, and other neutron-rich isotopes of K, Ca, Sc, and Ti were available for study as well. Seven implantations unambiguously identified as 52Ar based on energy loss, total energy, time-of-flight, and magnetic rigidity provided first evidence for the existence of this nuclide. We will report the β-decay half-lives of 51,52Ar deduced from event-by-event time correlations between implantations and subsequent β decays measured with the NSCL Beta Counting System.

1This work was supported in part by NSF grants PHY-06-06007, PHY-02-44453, and PHY-04-56463, US DOE contracts DE-AC02-06CH11357 and DE-FG02-ER40834, and Polish Science Committee grant P03B 059 29.

4:48PM ED.00003 Beta Decay Studies of Neutron-Rich Nuclei near 52Ca1 H.L. CRAWFORD, P.F. MANTICA, G.F. GRINYER, K. MINAMISONO, J.S. PINTER, J.B. STOKER, NSCL/MSU, R.V.F. JANSSENS, M. CARPENTER, B. KAY, L. LAURITSEN, S. ZHU, Argonne National Laboratory; R. BRODA, B. FORMAL, Institute of Nuclear Physics, Polish Academy of Sciences, N. HOTELING, I. STEFANESCU, Argonne National Laboratory/U. of Maryland, W.B. WALTERS, U. of Maryland — The β decay and isomeric properties of neutron-rich nuclei near semi-magic 52Ca were studied at NSCL. The presence of a significant energy gap, separating the neutron f3/2 and p3/2 single-particle states from the p3/2 level at N = 32, has a stabilizing effect on the low-energy structure of nuclei in this region. We report the results for the low-energy structure of 50K, which has one proton hole and one neutron hole outside 52Ca, determined from isomeric decay. We also discuss new levels in 51Sc, one proton outside 52Ca, populated following the β decay of 51Ca. Both findings reinforce previous evidence for the doubly-magic character of the 52Ca core.

1Work was supported in part by NSF under Grant No. PHY-06-06007 and by U.S. DOE, Office of Nuclear Physics, under contracts No. DE-AC02-06CH11357 (ANL) and DEFG02-94ER40834 (U. Maryland) and by the Polish Scientific Committee grant 1P03B 059 29.

5:00PM ED.00004 Study of the β-decay of 11Li at ISAC/TRIUMF, FRED SARAZIN, C.M. MATTOON, C. ANDREOIU, A. ANDREYEV, R.A.E. AUSTIN, G.C. BALL, R.S. CHAKRAWARTHY, D. CROSS, E.S. CUNNINGHAM, J. DAOUD, P.E. GARRETT, G.F. GRINYER, G. HACKMAN, D. MELCONIAN, C. MORTON, C. PEARSON, J. RESSLER, J. SCHWARTZENBERG, M.B. SMITH, C.E. SVENSSON, Colorado School of Mines — The β-decay of 11Li was investigated using the 8β β-decay spectrometer, an array of 20 Compton-suppressed HPGe detectors and 20 plastic scintillators for β-particle detection. Doppler-broadened line shapes resulting from the decay of excited states of 11Be populated by β-delayed neutron emission are analyzed using Monte Carlo simulations. New β-delayed neutron decay branches are shown to contribute to the complex decay of 11Li. Results, comparison with previous works, as well as implications for the beta-decay of the 11Li halonuclei will be discussed. This work is partially supported by the US Department of Energy through Grant / Contract No. DE-FG03-93ER40789.

5:12PM ED.00005 Fusion of 9Li with 208Pb, A.M. VINODKUMAR, W. LOVELAND, P. SPRUNGER, J. NEEWAY, L. PRISBREY, Oregon State University, M. TRINZEK, M. DOMBSKY, P. MACHULE, D. OTTEWELL, TRIUMF, J.J. KOLATA, A. ROBERTS, T. SPENCER, University of Notre Dame, OREGON STATE UNIVERSITY COLLABORATION, TRIUMF COLLABORATION, UNIVERSITY OF NOTRE DAME COLLABORATION — The fusion of weakly bound nuclei is one of the active areas of research with radioactive beams. The main issue is whether the fusion cross section will be enhanced due to large nuclear size of the halo nuclei or breakup of the weakly bound valence nucleons will lead to decreased fusion cross section. In the case of 11Li with 208Pb, differences between theoretical predictions are very large. We observed large sub barrier fusion enhancement in the case of 9Li with 76Zn. As an extension to this study, measurements were carried out at TRIUMF using 9Li beams in the energy range 25-45 MeV on 208Pb. The alpha decay of the evaporation residues were detected using 16 silicon detectors placed close to the target. The study of 9Li with 208Pb will be very important to understand the halo effect on fusion of 11Li with 208Pb. The experimental results will be presented along with theoretical model predictions.

5:24PM ED.00006 Studying the structure of the neutron-unbound 12Li, A. SPYROU, M. THOENENNEN, NSCL/MSU, P.A. DEYOUNG, C.C. HALL, Hope College, MONA COLLABORATION — The decay-energy spectrum of 12Li was measured in a neutron-fragment coincidence experiment at the National Superconducting Cyclotron Laboratory at MSU. 12Li was produced in the two-proton knockout reaction from a 14B secondary beam at 54 MeV/α. 12Li is neutron unbound and decays into 11Li and a neutron. The 11Li fragments were detected with position sensitive detectors behind the sweep magnet, while the Modular Neutron Array (MoNA) was used to detect the emitted neutrons. The decay energy of 12Li was reconstructed event-by-event from the four-momentum vectors of the two products. Two resonances were observed in the invariant-mass spectrum at ~200 keV and ~500 keV. The measurement of the structure of 12Li is an essential first step for the understanding of the two-neutron decay mode of 11Li. The latter was also measured during the experiment in the one-proton knockout reaction from 14Be and the analysis is in progress.

5:36PM ED.00007 N minus Z dependence of intruder states near the island of inversion1. SAMUEL TABOR, TRISHA HINNERS, VANDANA TRIPATHI, ALEXANDER VOLYA, Florida State University — Almost 3 decades after the discovery of deformed, intruder-dominated ground states in nuclei with Z ∼ 10 and N ∼ 20, many questions remain about the behavior of the N = 20 shell gap and how correlation effects can bridge the gap in this region of nuclei, later dubbed the “Island of Inversion,” because intruder states expected to lie at higher energies actually fall below the “normal” s-d states. Recent work has illustrated how some intruder dominated states fall systematically with increasing N and decreasing Z until reaching inversion. These N and Z dependences have been treated quite differently in the most successful calculations. The fall with increasing N is generally attributed to the rising Fermi level for neutrons, while the fall with decreasing Z seems to require a reduction in the N = 20 shell gap with lowering Z, perhaps due to the tensor interaction. The recent assignment of a negative-parity intruder band in 31Al at reduced energy and a subsequent survey of similar 4− bandheads in neighboring odd-odd nuclei has led to an intriguing discovery: the excitation energy of these lowest intruder states depends only on N minus Z to an accuracy of 10 to 20 keV.

1Supported in part by the U.S. National Science Foundation.
4:00PM EF.00001 Study of J/ψ production at low p_T in Cu+Cu collisions at \(\sqrt{s_{NN}} = 200\) GeV at STAR experiment, DANIEL KIKOLA, Lawrence Berkeley National Lab, STAR COLLABORATION — J/ψ production in Cu+Cu collisions at \(\sqrt{s_{NN}} = 200\) GeV has been measured by STAR experiment at RHIC. Cu+Cu is particularly interesting because it is positioned between d+Au where only cold nuclear matter effects are present and Au+Au where significant suppression due to hot nuclear matter was reported. In this talk the study of J/ψ production at low p_T in Cu+Cu at \(\sqrt{s_{NN}} = 200\) GeV will be reported. The J/ψ invariant yield and nuclear modification factor as a function of transverse momentum (up to 5 GeV/c) and centrality will be presented. The results of J/ψ in Cu+Cu will be compared to relevant p+p data, PHENIX Cu+Cu measurement and various theoretical models.

4:12PM EF.00002 Fast hadronization of charm, bottom and strange flavor in strangeness rich QGP, JOHANN RAFELSKI, INGA KUZNETSOVA, University of Arizona — We study QGP hadronization at a given b bottom, c charm and s strange quark content conserving entropy. We evaluate the final yields of charm and bottom flavored hadrons within statistical hadronization model. In fast hadronization at fixed reaction volume the high strangeness s and entropy S content of QGP leads to chemical non-equilibrium condition among final state charm and bottom hadrons. We predict a significant increase of their yield, compared a slow (chemical equilibrium) hadronization. Yields of hadrons with two heavy quarks, including J/ψ, decrease compared to expectations since charm (bottom) is ‘used up’ in strange hadron formation. This provides a new powerful mechanism of J/ψ and T suppression. The yield of light hadrons without strangeness depends mainly on the temperature T of hadronization and the related light quark fugacity \(\gamma_q\). However the ratio of non-strange to strange hadrons always decreases with increasing of \(s/S\).

4:24PM EF.00003 J/ψ production in STAR, PIBERO DJAWOTHO, Indiana University, STAR COLLABORATION — The production of heavy quarkonia states in p+p, p+A and A+A collisions provide an important tool to study the properties of Quark-Gluon Plasma. Their completion of the STAR Electromagnetic Calorimeter and with the increased luminosity provided by RHIC in Run 6 and 7, the study of J/ψ including \(J/\Psi\) including fixed reaction volume the high strangeness content conserving entropy. We evaluate the final yields of charm and bottom flavored hadrons within statistical hadronization model. In fast hadronization at fixed reaction volume the high strangeness s and entropy S content of QGP leads to chemical non-equilibrium condition among final state charm and bottom hadrons. We predict a significant increase of their yield, compared a slow (chemical equilibrium) hadronization. Yields of hadrons with two heavy quarks, including J/ψ, decrease compared to expectations since charm (bottom) is ‘used up’ in strange hadron formation. This provides a new powerful mechanism of J/ψ and T suppression. The yield of light hadrons without strangeness depends mainly on the temperature T of hadronization and the related light quark fugacity \(\gamma_q\). However the ratio of non-strange to strange hadrons always decreases with increasing of \(s/S\).

4:36PM EF.00004 Measurement of Electron-Muon Correlations from Semi-Leptonic D Decay in 200 GeV p+p Collisions at RHIC-PHENIX, TATIA ENGELMORE, Columbia University, PHENIX COLLABORATION — Charm production is a valuable probe of the early stages of a heavy ion collision. Correlated electron-muon pairs are a signature of semi-leptonic D decays, and a measurement of D mesons provides information on charm quark energy loss in the hot medium. The energy loss of heavy quarks is still not fully understood, so it is vital to investigate different decay channels of charm mesons to better understand this process. Measurements of electron-muon pairs suffer less from background than \(e^- \mu^-\) or \(e^+ \mu^+\) pairs since neither thermal production, Drell-Yan production, nor resonance decays produce this type of correlated signal. This talk will present the analysis of \(e^- \mu^+\) pairs in data taken during the 2006 RHIC run of p+p collisions at 200 GeV. It will be shown that a clear back-to-back peak exists in the azimuthal angular distribution of the pairs, indicating charm production. It will also be shown that background sources are small relative to this measurement. The study of electron-muon pairs in p+p collisions provides an important baseline and the first step towards the study of this process in d+Au and Au+Au collisions.

4:48PM EF.00005 Non-photonic electron identification in the EECM with the STAR detector, NARESH SUBBA, BRYON ANDERSON, WEI-MING ZHANG, Kent State University, STAR COLLABORATION — We report on progress to identify non-photonic electrons in the extended pseudo-rapidity range \(\eta = 1.1\) to 1.5 and transverse momentum \(p_T = 1.5\) to 6.0 GeV/c possible with the end-cap electromagnetic calorimeter (EECM) with the STAR detector system at RHIC. This identification will enable one to extract double differential electron distributions in order to help study open charm production in proton-proton interactions. In order to extract non-photonic electrons it is necessary to determine electron purity and photonic background removal efficiency. Backgrounds from both hadronic and photonic contributions are identified. The hadrons can be identified by the difference in energy deposition. The photonic contributions arise mainly from two sources, one from gamma conversion and the other from the (Dalitz) decay of mesons. Both processes can be identified from the observation of opposite-sign electron-positron pairs with low invariant mass. Detection efficiencies of photonic electrons can be obtained with Monte-Carlo simulations.  

\(^1\)Supported in part by the NSF and DOE

5:00PM EF.00006 Azimuthal angular correlations between non-photonic electrons and charged hadrons from p+p collisions at \(\sqrt{s_{NN}} = 200\) GeV in RHIC-STAR, SHINGO SAKAI, Univ. of California, Los Angeles, STAR COLLABORATION — Heavy quarks, charm and bottom, are believed to be produced mostly via initial gluon fusion in nuclear collisions at RHIC. Heavy quark propagation through the hot and dense medium created in heavy ion collisions probes the properties of the medium. Recently a large suppression of non-photonic electrons up to a \(p_T\) of 5 GeV/c) and centrality will be presented. The results of J/ψ in Cu+Cu will be compared to relevant p+p data, PHENIX Cu+Cu measurement and various theoretical models.

5:12PM EF.00007 Non-photonic electron-hadron azimuthal correlation for \(\sqrt{s_{NN}}=\text{GeV}200\) AuAu collisions at STAR/RHIC, BERTRAND Biritz, UCLA — STAR’s measurements on di-hadron correlations in Au+Au and Cu+Cu have shown a suppression of high-pT hadron yields and modifications in the azimuthal correlation. This modified correlation function suggests a broadening on the away-side. A similar pattern has been observed in the correlation triggered by non-photonic electrons, which represent the directions of heavy quarks. Study of the particle emission pattern in the dense QCD medium will provide insight on the mechanism responsible for the pattern and the flavor dependence. This talk will present preliminary STAR results of azimuthal correlations between non-photonic electrons and hadrons in Au+Au at \(\sqrt{s_{NN}}=\text{GeV}200\) and compare them to results for Cu+Cu at \(\sqrt{s_{NN}}=\text{GeV}200\). This comparison allows one to study the system-size dependence of heavy quark energy loss and emission broadening of its associated particles.
5:24PM EF.00008 Azimuthal Correlations of Electrons from Heavy Flavor Decay with Hadrons at PHENIX , ANNE SICKLES, Brookhaven National Laboratory, PHENIX COLLABORATION — One unexpected recent result from heavy-ion collisions is the large suppression and elliptic flow of electrons from heavy flavor decay. Further measurements of properties of electrons from heavy flavor decay are crucial to understanding the origin of this suppression and heavy flavor measurements are expected to be sensitive to the properties of the produced matter. We study the azimuthal correlations between electrons from heavy flavor decay and hadrons. Two particle correlations have been used extensively to study the propagation of hard partons through the produced matter in heavy-ion collisions. We apply techniques developed for direct photon-hadron correlations to statistically subtract correlations of electrons arising from Dalitz decays and photon conversions from the inclusive electron-hadron correlations and we present the current status of two-particle correlations between electrons from heavy flavor decay and charged hadrons in Au+Au collisions in the PHENIX experiment.

5:36PM EF.00009 D-Meson Measurements in Cu+Cu Collisions at $\sqrt{s} = 200$GeV at STAR Using the Silicon Inner Tracker . SARAH LAPONTE, Wayne State University, STAR EXPERIMENT AT RHIC COLLABORATION — Since the most likely production mechanism for charm is gluon fusion, the charm cross section should scale with the number of binary collisions. Such a scaling would indicate that the production of charm occurs during the early stages of the collision, making it a unique probe of the partonic matter. Recent measurements provide some insight of the heavy flavor spectrum and collectivity. Non-photonic single electron $p_T$ distributions measured in p+p, d+Au, and Au+Au collisions indicate the nuclear modification factor is significantly below unity for $p_T > 1$-4 GeV/c for central events. This implies the heavy flavor spectrum is modified by the medium. However, due to an uncertainty in the relative fraction of charm and bottom, this measurement does not enable an unambiguous determination of energy loss that charm experiences in the medium. The event mixing technique has also been used to reconstruct D. However, it does not provide the statistical significance necessary to perform a good measurement of charm elliptic flow. In this talk, we present preliminary results from D-Meson measurements in minimum bias Cu+Cu collisions at $\sqrt{s} = 200$GeV at STAR. The measurements are performed using a secondary vertexing technique. They provide a basis for future measurements of charm cross section, energy loss and collectivity in heavy ion collisions at RHIC.

5:48PM EF.00010 Open Charm Production in $\sqrt{s_{NN}} = 200$GeV Cu+Cu collisions at Forward Rapidity , IRAKLI GARISHVILI, University of Tennessee, PHENIX COLLABORATION — Open charm production is an important probe of the strongly interacting matter created during the early stages of heavy ion collisions. Single muons are used to tag open charm production via semileptonic decays of D-mesons. The PHENIX detector at RHIC is used to measure single muon production at forward and backward rapidities over the range of 1.1 $> |$η$| > 2.25$. PHENIX has previously measured single muon production for p+p collisions at $\sqrt{s_{NN}} = 200$GeV, which is used as a baseline measurement for calculating the Nuclear Modification Factor (R_{AA}) for heavy ion collisions. The status of the first measurement in Cu+Cu collisions at $\sqrt{s_{NN}} = 200$GeV of single muon cross sections and nuclear modification factors as a function of transverse momentum will be presented.

Friday, October 24, 2008 4:00PM - 5:48PM — Session EG Applications of Nuclear Physics Jewett Ballroom C

4:00PM EG.00001 Energy-Dependent $Q$ Values for Fission , RAMONA VOGT, LLNL and UC Davis — We extend Madland’s parameterization of the energy release in fission [1] to obtain the dependence of the fission $Q$ value for major and minor actinides on the incident neutron energies in the range $0 \leq E_n \leq 20$ MeV.


1 This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344 and was also supported in part by the National Science Foundation Grant NSF PHY-0555660.

4:12PM EG.00002 Gamma Ray Multiplicity Comparison of a 2-Neutron and a 4-Neutron Emission $^{252}$Cf Spontaneous Fission , D.L. BLEUEL, L.A. BERNSTEIN, J.T. BURKE, M.D. HEFFNER, E.B. NORMAN, N.D. SCIELZO, S.A. SHEETS, N.J. SNYDERMAN, M.A. STOYER, M. WIEDEKING, Lawrence Livermore National Laboratory, J. GIBELIN, L.W. PHAIR, Lawrence Berkeley National Laboratory, J. MINTZ, University of California at Berkeley — The correlation between $\gamma$-ray multiplicity and neutron multiplicity in the fission process is not currently well known. Competing theories predict opposite correlations and experiments have measured only average properties. We have measured the $\gamma$-ray multiplicity spectrum of $^{252}$Cf spontaneous fission using the LiBerACE array, comprised of six high-purity germanium (HPGe) Clover detectors, each surrounded by 16 bismuth-germanate (BGO) detectors. The Clovers were arranged in a cubic pattern around a 1 $\mu$Ci $^{252}$Cf source. Neutron multiplicity was determined for two cases by identifying known correlated fission products from prompt $\gamma$-rays observed in the HPGe detectors. No difference in the $\gamma$-ray multiplicity spectrum was observed for fissions that produced $^{106}$Mo/$^{144}$Ba (2 neutrons) compared to those producing $^{106}$Mo/$^{144}$Ba (4 neutrons).


4:24PM EG.00003 Precision Cross Section Measurement for the $^{241}$Am($\gamma,n$) Reaction at HI/$S$ , A. TOLCHEV, A. HUTCHESON, C.R. HOWELL, E. KWAN, G. RUSEV, W. TORNOW, Duke and TUNL, S. HAMMOND, H.J. KARWOWSKI, UNC and TUNL, C. HUBREGTSE, J.H. KELLEY, NCSU and TUNL, D.L. JEWETT, L.E. KELSEY, J.G. WILHELMS, L.A. STOYER, LLNL — The photodisintegration cross section on radioactive $^{241}$Am target has been measured for the first time using monoenergetic $\gamma$-ray beams from the HI/$S$ facility. Induced activity from $^{240}$Am produced via the ($\gamma,n$) reaction was activated using high resolution HPGe detectors. The ($\gamma,n$) cross section was determined both by measuring the absolute $\gamma$-flux and by comparison to the $^{197}$Au($\gamma,n$) cross section used as a standard. In the following, we report new data for the excitation function of the $^{241}$Am($\gamma,n$) reaction from near threshold to 16 MeV incident $\gamma$-ray energy and we compare the data with statistical nuclear-model calculations performed with the GNASH, EMPIRE, and TALYS codes.

1 This work was supported by the National Nuclear Security Administration under the Stewardship Science Academic Alliances Program through Department of Energy grant DE-FG52-06NA26155.
4:36PM EG.00004 Ultra-Low 40K Background Measurements for SNO+ using AMS, DANIEL ROBERTSON, University of Notre Dame, JOHN BAKER, Idaho National Laboratory, MATTHEW BOWERS, University of Notre Dame, PHILIPPE COLLON, University of Notre Dame, JARET HEISE, Queens University, KARA KEETER, Idaho State University, CHRISTOPHER SCHMITT, University of Notre Dame, EDDIE TATAR, CHARLES TAYLOR, Idaho State University, WENTING LIU, University of Notre Dame, SNO+ COLLABORATION — Whilst striving for better sensitivity, experiments studying rare process such as neutrino and dark matter interactions are forced underground to achieve the ultra-low levels of radioactive background they demand. In conjunction with this, Accelerator Mass Spectrometry (AMS) can be used to achieve the ultra-low sensitivity required for detector 0.1% inner selection. One project interested in such techniques is SNO+ which proposes to study low-energy solar neutrinos as well as other neutrino processes via double-beta decay using a liquid scintillator called linear alkylbenzene (LAB). Due to the lower energy threshold of the detector, the present materials need to be re-evaluated for concentrations of 40K. Ultra-pure copper cathodes as well as samples of materials to be used in the detector have been developed at Idaho State University and Idaho National Laboratory. These materials are being tested for levels of 40K at the Notre Dame AMS facility. Proof of principle and results from the first set of measurements will be discussed. This work is supported in part by NSF grant no. 0653642.

4:48PM EG.00005 Measurement of 39Ar/Ar ratios using AMS on underground argon samples using the newly developed ultra-pure Al lined plasma chamber, P. COLLON, M. BOWERS, Univ. of Notre Dame, F. CALAPRICE, C. GALBIATI, Princeton Univ., C.L. JIANG, D. HENDERSON, ANL, W. KUTSCHERA, Univ. of Vienna, H.H. LOOSLI, Univ. of Bern, R. PARDO, ANL, M. PAUL, Hebrew Univ. of Jerusalem, E. REHM, ANL, D. ROBERTSON, C. SCHMITT, Univ. of Notre Dame, R. SCOTT, R. VONDRAKER, H.Y. LEE, ANL — The first application of 39Ar AMS at the ATLAS linac of Argonne National Laboratory (ANL) to date ocean water samples relevant to oceanographic studies has been successfully and has been reported on. In particular the use of a quartz liner in the plasma chamber of the Electron Cyclotron Resonance (ECR) ion source enabled a potassium reduction of a factor ~100 compared to previous runs without liners and allowed measurements down to 39Ar/Ar = 4.2x10^-17. We are currently working on improving the AMS method for 39Ar by following two ion source development paths to allow for higher Ar beam currents coupled to lower 40K background rates. Both methods are combined with new cleaning techniques developed for removing both particulates and other materials from surfaces, largely driven by the semiconductor industry. The driving force for the use of AMS to measure 39Ar is to search for a source of argon that has a low concentration of 39Ar. Such a source of argon would be useful for new liquid argon detectors that are being developed for detecting dark matter WIMPs (Weakly Interacting Massive Particle), such as that to be installed at the new DUSEL (Deep Underground Science and engineering laboratory) facility at Homestake in the US.

5:00PM EG.00006 Charge State Measurements with Photocell Detectors, CHRIS SCHMITT, MICHAEL CARILLI, PHILIPPE COLLON, ANDREAS HEINZ, JAY LAVERNE, DANIEL ROBERTSON, SEAN SULLIVAN, UNIVERSITY OF NOTRE DAME TEAM, YALE UNIVERSITY COLLABORATION — Measuring charge state distributions (CSD) of few electron systems, like lithium, through various targets can provide information to fill gaps in existing models. There is a need to look at target and ion velocity dependence for few electron systems and compare them with heavy ion interactions. Ultimately, there is a scientific need to probe the interactions between ion and target in order to understand the influences that each have on one another. The development, building, and characterizing of a photocell array creates an effective tool for making measurements in ion beam experiments. Photodiodes as detectors provide distinct advantages over conventional silicon detectors in a laboratory setting. They are less sensitive to radiation damage, cost effective, easily replaceable, and a valuable teaching tool for undergraduates and graduate students alike. Other than a teaching tool their immediate and experimental application will be as a beam monitor. The data presented shows test chamber results, the effects of beam induced damage, and first CSD measurements.

5:12PM EG.00007 Progress on a Polarimeter for the Deuteron EDM Search, E.J. STEPHENSON, Indiana University Cyclotron Facility, DEUTERON EDM COLLABORATION — The design of the storage ring for the deuteron electric dipole moment (EDM) search uses crossed E and B fields to nearly stop the magnetic moment precession of the deuteron in the ring bending magnets. This allows time for the EDM (whose predession is based on E = γv × B) to generate a detectable vertical polarization component [1]. A polarium for the EDM ring must monitor continuously and with high statistical precision. Recent tests at COSY-Jülich have demonstrated high efficiencies (~ 10%) and low backgrounds (~ 10^-5), so the polarimeter is in place. Measurements of the deuteron EDM will be performed at LLNL using a thick-walled carbon tube target that also provides the beam aperture. Extraction onto the target was tested using beam position and beam heating with a cluster jet target or a white-noise electric field. Systematic errors were investigated. Continuous monitoring demonstration measurements were made using an RF solenoid whose frequency was ramped through the 1 – Gγ depolarizing resonance. [1] F.J. Farley et al, Phys. Rev. Lett. 93. 052001 (2004).

5:24PM EG.00008 Testing and Calibration of Novel Detectors for Nuclear and Plasma Physics Diagnostic Applications, ZAHEER ALI, National Security Technologies, LLC, MIKE HAUGH, JIM TELLINGHUISEN, VLADIMIR GLEBOV, Lab for Laser Energetics, University of Rochester, SAM ROBERTS, CHRISTIAN STOECKL, CRAIG SANGSTER — Calibrated chemical vapor deposition (CVD) diamond diodes, X-ray diodes (XRDs), and PIN diodes are used in nuclear and plasma physics diagnostic experiments, such as those conducted at the National Ignition Facility at Lawrence Livermore National Laboratory (LLNL). Calibrations of these diodes are conducted at the OMEGA Laser at the Lab for Nuclear Energetics of the University of Rochester, as well as at the Titan Laser in the Jupiter Laser Facility at LLNL. The OMEGA Laser is a 30-kilijoule one-nanosecond system designed for inertial confinement fusion and nuclear physics research. The Titan Laser is a picosecond system designed for plasma and X-ray studies. In addition, National Security Technologies, LLC, (NSTec) has built a new hard X-ray calibration facility (the “HEX Laboratory”), where X-ray detector systems are also calibrated. In this paper we will present our methods of absolute and relative calibration, results of calibration, and the capabilities of the HEX Laboratory.

5:36PM EG.00009 Nuclear Excitation via Auger Transitions (NEAT), THOMAS WARD, Techosource Inc., GUY EMERY, Boudoin College, JOHN RASMUSSEN, University of California at Berkeley, HUGON KARWOWSKI, University of North Carolina, CARLOS CASTANEDA, University of California at Davis — Triggering (prompt de-excitation) of isomeric states produced in a process of coupling nuclear excitations to atomic shells via Auger transitions (NEAT) is studied. In this resonant process the nuclear transition energy between the two states must be less than the Auger transition energy. This requires the emitted Auger electron energy and the exact on-resonance nuclear excitation share the Auger transition energy. NEAT is compared to other proposed processes of nuclear excitation produced by x-rays (NEET), by electron capture (NEEC) and bound internal conversion (BIC), all of which suffer from off-resonance nuclear excitation except in those accidental cases where the energies may coincide. Estimates of the total resonance strength will be given for the case of 192W/H f which has been extensively studied theoretically. A second case, 193Os, where NEAT processes may contribute to the nuclear resonance fluorescence (NRF) of the ground state to the 5.8hr isomeric state will also be examined as a good case for experimental verification of the NEAT process.
8:30AM FA.00001 An Overview of Experiments in Neutron Beta Decay. WILLIAM SNOW, Indiana University/IUCF — Experiments in neutron and nuclear beta decay continue to probe certain aspects of the standard electroweak model. The neutron is simple enough that precise measurements can be interpreted with theoretical clarity. Over the last few years several new experiments have been conducted and proposed both to improve the precision of previous work and also to search for new observables. In this talk we will attempt an overview of the present state of this field of activity.

9:06AM FA.00002 The study of neutron quantum states in the Earth’s gravitational field. STEFAN BAESSLER, University of Virginia — I will discuss the discovery and characterization of gravitational bound neutron states. In the previous experiments, the lowest neutron quantum states in the gravitational potential were distinguished and characterized by a measurement of their spatial extent. The future detection of resonant transitions between these neutron quantum states with the help of the GRANIT spectrometer (under construction) promises to give further and more precise information. Here, transitions between different quantum states induced by RF pulses shall be observed. These measurements are not only demonstrations of standard quantum mechanics. I will discuss applications of these measurements in the search for spin-dependent short-range interactions.

9:42AM FA.00003 Precision Neutron Scattering Length Measurements Using Neutron Interferometry1. FRED WIETFELDT, Tulane University — The neutron interferometer, pioneered by Werner and Rauch in the 1970’s, splits the neutron matter wave into two paths by Bragg diffraction in a perfect silicon crystal, then recombines them coherently to produce a interference signal measured by a neutron counter, thereby directly obtaining an interaction amplitude via the phase shift. It has been used to make famous demonstrations of quantum phenomena that are now found in many textbooks. It is also an ideal instrument for precision measurement of low-energy neutron scattering lengths that are important for developing and testing nuclear potential models and effective field theories, and probing neutron substructure. I will describe previous experiments and the current program at the NIST Neutron Interferometry and Optics Facility.

Saturday, October 25, 2008 8:30AM - 10:18AM –
Session FB Mini-Symposium: Nuclear Physics Research and Connections to Nuclear Energy I
Room 208

8:30AM FA.00001 Basic Nuclear Physics Research Needs for Nuclear Energy. TONY HILL, Los Alamos National Laboratory — Basic nuclear physics research will play a central role in the development of the future nuclear facilities. Federal requirements for higher efficiencies, lower operating and construction costs, and advanced safeguards can all be impacted by the quality of nuclear data used in the fuel cycle calculations for design and licensing. Uncertainties in the underlying nuclear data propagate to uncertainties in integral and operational parameters, which drive margins and cost. Department of Energy (DOE) programs are underway to help develop the necessary nuclear research infrastructure. The Nuclear Energy office of DOE leads the development of new nuclear energy generation technologies to meet energy and climate change goals and advanced, proliferation resistant nuclear fuel technologies that maximize energy from nuclear fuel, while maintaining and enhancing the national nuclear infrastructure. These activities build on important work started over the last three years to deploy new nuclear plants in the United States by early in the next decade, and to develop advanced, next-generation nuclear technology. In this talk, I will discuss some of the foreseen opportunities and needs for basic nuclear research in nuclear energy.

9:06AM FA.00002 Determining cross sections for low-energy neutron capture reactions via the Surrogate method1. JUTTA ESCHER, FRANK DIETRICH, NICHOLAS SCIELZO, Lawrence Livermore National Laboratory, CHRISTIAN FORSSSEN, Chalmers University of Technology — The Surrogate Nuclear Reactions method, an indirect approach for determining compound-nuclear reaction cross sections, has recently received renewed attention. The method has primarily been employed to determine [n,f] cross sections for various actinides, including unstable isotopes. Cross sections for other reactions, in particular (n,γ) reactions on short-lived targets, are of interest as well, but are more difficult to extract from Surrogate measurements. This contribution will focus on the prospects for employing the Surrogate method to obtain neutron-capture cross sections for applications in the areas of astrophysics and nuclear energy. Progress made in understanding the impact and treatment of the spin mismatch between the desired (neutron-induced) and Surrogate reactions will be summarized. Calculations will be presented that assess the validity of employing various approximate treatments in the interpretation of Surrogate measurements and insights gained from recent experiments will be discussed.

9:18AM FB.00003 Measuring the 239U(n,f) cross section using a two neutron transfer surrogate reaction. JASON BURKE, LLNL, STARS/LIBERACE COLLABORATION — Measuring fission cross sections of unstable short lived actinides has been a difficult challenge to experimental physicists for decades. Cross sections for neutron induced reactions are essential for basic and applied science fields of study such as nuclear astrophysics and nuclear reactor design. Surrogate reactions offer an alternative approach to direct measurements. I will present our work on the surrogate two neutron transfer reaction 239U(n,f)16O,18O)239U used to obtain the fission cross section of 235U(n,f) by comparing it to the known 235U(n,f) cross section obtained via the 234U(16O,18O)236U reaction. This work was performed under the auspices of the U.S. Department of Energy under contract numbers DE-AC52-07NA27344 (LLNL), DE-AC02-05CH11231 (BNL) and DE-FG52-06NA26506 (UR).

9:30AM FB.00004 Surrogate reactions on fission fragments for nuclear energy1. R. HATARIK, J.A. CIZEWSKI, W.A. PETERS, Rutgers University, D.W. BARDAYAN, S.D. PAIN, Oak Ridge National Laboratory — Neutron capture cross sections on unstable nuclei are important for many applications in nuclear structure, astrophysics, for the advanced fuel cycle initiative and other applied programs. Measuring these cross sections directly is impossible for short lived species and theoretical calculations often do not have the required accuracy. An alternative approach is to measure the neutron transfer reaction (d,pγ), which can be done using radioactive beams and CD2 targets and has been demonstrated to be a surrogate for (n,γ). This talk would present the status of (d,pγ) measurements with radioactive ion beams and prospects for measurements with fission fragments.

1Work supported in part by U.S. Department of Energy and National Science Foundation.

1Work sponsored by NSF grant PHY-0555347 and NIST (U.S. Dept. of Commerce).
9:42AM FB.00005 Benchmarking the Surrogate Ratio Method Using the $\alpha,\alpha'$ reaction. S.R. Leshier, L.A. Bernstein, J.T. Burke, D.L. Bleuel, F.S. Dietrich, J.E. Escher, B.F. Goldblum, K.J. Moody, E.B. Norman, N.D. Scielzo, L.L.N.L., H. Al, Yale Univ., C.W. Beausand, Univ. of Richmond, R.M. Clark, P. Fallon, J. Gibelin, I.Y. Lee, A.O. Macchiaveli, M.A. McMahann, L. Phair, E. Rodriguez-Vieitez, M. Wiedeking, LBNL — The Surrogate Ratio Method is a technique that can be used to obtain neutron induced reaction cross sections on unstable nuclei. Using the 88-Inch Cyclotron at LBNL and the Silicon Telescope Array for Reaction Studies (STARS), $^{235}$U and $^{238}$U were excited via inelastic $\alpha$ particle scattering. Fission events from the decay of these nuclei were detected in coincidence with the alpha particles. The ratio of their fission probabilities was compared to the known $^{235}$U(n,f) / $^{238}$U(n,f) cross-section ratio and found to agree over an excitation energy range of 7 – 25 MeV. This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory in part under Contract W-7405-Eng-48 and in part under Contract DE-AC52-07NA27344 and Grant Nos. DE-FG52-06NA26206 and DE-FG02-05ER41379. This work was also supported by the Director, Office of Science, Office of Nuclear Physics of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

9:54AM FB.00006 How Can the Accuracy of Neutron Nonelastic Cross Sections be Improved?1, FRANK DIETRICH, Lawrence Livermore National Laboratory — The nonelastic cross section for incident neutrinos is particularly important for applications because it directly determines the sum of all reaction processes other than elastic scattering, and is closely related to the compound-nucleus formation cross section. Scatter in available measurements of the nonelastic cross section shows that this quantity is not known very accurately ($\approx$5–10%). We will show examples of this, together with results from a new technique that shows promise of reducing uncertainties to $\approx$2–3% in the range of a few MeV to a few tens of MeV [1]. Comparison of results using this technique on Fe, Pb, Th, and U with optical model calculations suggests that optical potentials are not reliable for predicting nonelastic cross sections to better than $\approx$5%, even when they reproduce total cross sections well ($\approx$1%). We will suggest a limited set of high-accuracy measurements of nonelastic cross sections that could be made to guide the further development of optical models that are able to predict nonelastic cross sections reliably.

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

10:06AM FB.00007 A Gas Electron Multiplier (GEM) Detector for Fast Neutron Imaging. C.C. Jewett, University of California at Berkeley, M. McMahann, Lawrence Berkeley National Laboratory, J. Cerny, University of California at Berkeley and Lawrence Berkeley National Laboratory, L. Heilbronn, M. Johnson, Lawrence Berkeley National Laboratory — We have built a Gas Electron Multiplier (GEM) detector for detection of fast neutrons at Lawrence Berkeley National Laboratory. The detector consists of a 0.0625 inch thick polypropylene neutron converter, three GEM foils and a grid of 16 readout pads on a printed circuit board. In this talk, we present images of the GEM detector, the results of tests with $^{60}$Co, AmBe sources and our neutron beam, and a comparison between the proposed fast neutron GEM detector and a fast neutron $^{238}$U fission chamber we purchased. One of the advantages of the GEM detector over the fission chamber is the fact that it provides the $x$-$y$ position information of the neutrons.

Saturday, October 25, 2008 8:30AM - 10:18AM — Session FC Mini-Symposium: Neutrino Properties and Nuclear Physics III Jewett Ballroom A-B

8:30AM FC.00001 New Neutrino Oscillation Results from MiniBooNE. RICHARD VAN DE WATER, Los Alamos National Laboratory — The first MiniBooNE neutrino oscillation results published April of 2007 ruled out the simple two neutrino oscillation hypothesis of the LSND experiment. However, MiniBooNE unexpectedly observes a significant excess of electron-like events below a reconstructed neutrino energy of 475 MeV. An updated analysis of this low energy region will be presented.

9:06AM FC.00002 Neutrino Interactions with Nuclei1, ULRICH MOSEL, TINA LEITNER, Universitaet Giessen — We investigate interactions of neutrinos with nuclei at intermediate energies, incorporating quasielastic scattering and the excitation of nucleon resonances and their decay as elementary processes. The calculations take into account medium effects such as Fermi motion, Pauli blocking, mean-field potentials and in-medium spectral functions. A coupled-channel treatment of final state interactions, both inclusive and exclusive. Results for neutrino-induced inclusive cross sections, as well as for pion production and nucleon knockout, are presented and compared with present day experiments.

1Work supported by DFG

9:18AM FC.00003 Charged current single pion to quasi-elastic cross section ratio. STEVEN LINDEN, Yale University, MINIBOONE COLLABORATION — Charged current $\pi^+$ (CCPi+) interactions are important in many neutrino experiments, including those studying neutrino oscillations, but the cross section for this process is not well understood at low energies. We present a new measurement of the CCpi+ cross section as a ratio to the charged current quasi-elastic cross section for muon neutrinos on mineral oil in the MiniBooNE experiment. With more than 46,000 CCpi+ events collected in MiniBooNE, this measurement represents a dramatic improvement in statistics and precision over previous results at low energies.

9:30AM FC.00004 Neutrino quasi-elastic scattering measured with MINERvA1, RONALD RANSOME, Rutgers University, MINERvA COLLABORATION — The MINERvA experiment is a high precision neutrino scattering experiment designed to improve our understanding of the neutrino-nucleus interaction. The detector will use a fully active scintillation detector to allow full event reconstruction, as well as 4He, and thin C, Fe, and Pb targets to study the nuclear dependence of the interaction. The experiment is planned to start a four year run in 2010 in the NuMI Beamline at Fermilab. The axial form factor can be extracted from quasi-elastic scattering from the different nuclear targets. A discussion of the estimated precision and systematic uncertainties will be presented.

1Supported in part by the National Science Foundation

9:42AM FC.00005 Unexpected Nuclear Effects in $\nu$-Fe Interactions and MINERvA’s Program to Measure Neutrino Scattering off a Range of Nuclei. JORGE G. MORFIN, Fermilab — Recent studies of nuclear effects in $\nu$-Fe data by members of the CTEQ collaboration suggest that nuclear effects as seen by neutrinos are very different compared to those from $\mu$-Fe scattering. The MINERvA experiment will measure $\nu$-A scattering off of He, C, Fe and Pb to systematically study these nuclear effects in neutrino interactions with high statistics. The CTEQ results and an outline the MINERvA program for measuring nuclear effects will be presented.
9:54AM FC.00006 On the electroweak physics reach of the NuSOnG experiment. JAMES JENKINS1, Los Alamos National Lab, NUSONG COLLABORATION — I present on the electroweak physics potential of the proposed NuSOnG (Neutrino Scattering On Glass) experiment at Fermilab. NuSOnG’s design and projected interaction rates suggest a unique physics program that can indirectly probe energy scales in excess of 5 TeV, comparable to that of the LHC! However, due to their weak current nature, neutrino scattering yields information complementary to conventional colliders in physics content. After introducing the general motivation for neutrino scattering at NuSOnG I move on to describe precision, multi-channel, measurements of Standard Model parameters. Next, I survey both direct and indirect searches for new physics via nonstandard neutrino couplings and potential Z prime interactions. This is supplemented throughout by a discussion of example models that may be constrained by this experiment.

1 Currently Northwestern University

10:06AM FC.00007 First Measurement of Neutrino Events in an Off-Axis Horn-Focused Neutrino Beam. ZELIMIR DJURCIC, Columbia University — The purpose of the MiniBooNE experiment at Fermilab is to perform a $\nu_{\mu}$ $\rightarrow \nu_e$ oscillation search in the Booster Neutrino Beam (BNB) beamline. However, the MiniBooNE Experiment reports the first observation of off-axis neutrinos from the NuMI beamline at Fermilab. Measurements of NuMI neutrino interactions in MiniBooNE provide a clear proof-of-principle of the off-axis beam concept that is being planned for use in future neutrino experiments such as T2K and NovL. The comparison between data and simulation for both charged current quasi-elastic $\nu_\mu$ and $\nu_e$ events provides a direct check of the expected pion and kaon contributions and validates the modeling of the NuMI off-axis beam. The beam energy at the MiniBooNE location and the distance from the NuMI target to the MiniBooNE detector result in a $(L/E)$-ratio comparable to the BNB. The NuMI off-axis events are dominated by intrinsic $\nu_e$ events and therefore subject to different systematics when compared to the BNB neutrinos. Therefore, the data from the NuMI beamline provide an important complementary sample to pursue an oscillation search. The latest analysis results will be presented.

Saturday, October 25, 2008 8:30AM - 10:18AM — Session FD Mi-Symposium: Rare Isotope Science IV Jewett Ballroom G-H

8:30AM FD.00001 First identification of the $g_9/2$ band in the neutron-rich $71,73,75$ Ga isotopes produced in deep-inelastic reactions1. I. STEFANESCU, N. HOTELING, W.B. WALTERS, University of Maryland, M.P. CARPENTER, R.V.F. JANSSSENS, T. LAURITSEN, D. SEWERYNIK, S. ZHU, ANL, R. BRODA, B. FORNAL, W. KROLAS, T. PAWLAT, INP Krakow, Poland — Deep-inelastic reactions proved to be a very powerful technique for the study of high-spin states in the neutron-rich nuclei around $^{68}$Ni. This kind of reactions produced significant broadening of the experimental knowledge in the neutron-rich Fe, Ni, Cu and Zn isotopes. Such information, consisting of a number of isometric states and rotational-like structures is extremely important for the understanding of the effects of the N=40 subshell closure on the collective properties in this mass-region. In the present paper we report the first identification of the bottom part of the $g_9/2$ proton band in the neutron-rich $^{71,73,75}$Ga produced in deep-inelastic reactions at Argonne National Laboratory. The bands exhibit a rotation aligned-like character suggesting moderate prolate deformation for these nuclei. A surprisingly constant level spacing with increasing the neutron number is observed experimentally, contrary to the expectation that the addition of a pair of $g_9/2$ neutrons induces an increase in collectivity.

1 Supported by DOE DEFG02-94ER40834, DE-AC02-06CH11357 and Polish Grant 2PO3B-074-18.

8:42AM FD.00002 New Band Structures in Neutron-Rich $^{108}$Mo, and $^{108,110,112}$Ru. J.H. HAMILTON, Y.X. LUO, A.V. RAMAYYA, C. GOODIN, K.L., J.K. HWANG, Vanderbilt Univ., S.J. ZHOU, H.-B. DING, X.L. CHE, Tsinghua Univ., J.O. RASMUSSEN, J.Y. LEE, LBNL, D. ALMEHED, S. FRAUENDORF, V. DIMITROV, Univ. Notre Dame, J.Y. ZHANG, N.J. STONE, Univ. of TN, G.M. TER-AKOPIAN, A.V. DANIEL, JINR, M.A. STOYER, LLNL, R. DONANGELO, Univ. Fed. do Rio Janeiro, J.D. COLE, INL — New insights into the structures of $^{108}$Mo, and $^{108,110,112}$Ru are identified in the spontaneous fission of $^{252}$Cf. The $5.7 \times 10^{11}$ triples and higher fold prompt gamma coincidences opened up the possibility to see new weakly populated band structures in these nuclei. Two phonon $\gamma$-bands that decay only to the one phonon $\gamma$-band were discovered in $^{108}$Mo and $^{110,112}$Ru. We discovered in $^{108}$Mo and $^{110,112}$Ru $\Delta\lambda=1$, doublet bands. Our theoretical calculations indicate $^{108}$Ru is $\gamma$-soft and $^{110,112}$Ru are more rigid triaxial nuclei. The non-yrast band in $^{108}$Ru shows an energy level staggering not seen in its yrast partner band nor in $^{110,112}$Ru. This staggering is proposed to be related to its $\gamma$-soft shape perturbing its chiral structure. The doublet bands in $^{108}$Mo and $^{110,112}$Ru strongly support the chiral vibrational interpretation of these bands but do not support their being accidentally degenerate energy doublets built on different configurations.

8:54AM FD.00003 Measurement of (d,p) reactions near the doubly-magic $^{132}$Sn. STEVEN PAIN, ORNL/UT, ORRUBA/RIBENS COLLABORATION — Measurements of (d,p) reactions on n-rich fission fragments yield important information on nuclear structure away from stability, and are of astrophysical interest due to the proximity to suggested r-process paths. The energies, spins and spectroscopic information of single-particle states near to shell closures are of particular importance, since they provide both an important constraint on nuclear-model predictions and are directly relevant to direct neutron-capture cross sections. The development of re-accelerated fission fragment beams at the HRIBF at ORNL has, for the first time, made possible the measurement of (d,p) reactions at the Coulomb barrier on nuclei around the doubly-magic $^{132}$Sn nucleus. The $^{130}$Sn(d,p)$^{131}$Sn, $^{132}$Sn(d,p)$^{133}$Sn and $^{134}$Te(d,p)$^{135}$Te reactions have been measured at the HRIBF at around 4.5 MeV/A utilizing deuterated plastic targets. Proton ejectiles were detected forward and backwards of $\theta_{lab}=90^\circ$ using an early implementation of the Oak Ridge Rutgers University Barrel Array (ORRUBA) in conjunction with the Silicon Detector Array (SIDAR). Details of the experiments and the data analysis, including excitation energies and angular distributions for the states populated, will be presented. *This work is supported in part by the U.S. Department of Energy and the National Science Foundation.

9:06AM FD.00004 The $^{132}$Sn + $^{96}$Zr reaction: a study of fusion enhancement/hindrance. WALTER LOVELAND, A.M. VINODKUMAR, JAMES NEEWAY, PETER SPRUNGER, LANDON PRISBREY, Oregon State University, DONALD PETERSON, Argonne National Laboratory, J.F. LIANG, DAN SHAPIRA, Oak Ridge National Laboratory, C.J. GROSS, Oak Ridge National Laboratory, R.L. WARNER, Oak Ridge National Laboratory, J.J. KOLATA, A. ROBERTS, University of Notre Dame, A.L. CARALEY, State University of New York at Oswego — Capture-fission cross sections were measured for the collision of the massive nucleus $^{132}$Sn with $^{96}$Zr at center of mass energies ranging from 192.8 to 249.6 MeV in an attempt to study fusion enhancement and hindrance in this reaction involving very neutron-rich nuclei. Coincident fission fragments were detected using silicon detectors. Using angle and energy conditions, deep inelastic scattering events were separated from fission events. Coupled channels calculations can describe the data if the surface diffuseness parameter, a, is allowed to be 1.10 fm, instead of the customary 0.6 fm. The measured capture-fission cross sections agree moderately well with model calculations using the dinucel system (DNS) model. If we use this model to predict fusion barrier heights for these reactions, we find the predicted fusion hindrance, as represented by the extra push energy, is greater for the more neutron-rich system, lessening the advantage of the lower interaction barriers with neutron rich projectiles.
9:18AM FD.00005 Production of neutron-rich isotopes in reactions at beam energies well above the Coulomb Barrier

A. SHAOFEI ZHU, R.V.F. JANSSENS, M.P. CARPENTER, C.J. CHIARA, E. JACKSON, B.A. KAY, F.G. KONDEV, T. LAURITSEN, E.A. MCCUTCHEON, D. SEWERYNIAK, Argonne National Laboratory, N. HOTELING, I. STEFANESCU, University of Maryland, B. FORMAL, Institute of Nuclear Physics, Poland — An experiment with a 48Ca beam at an energy of 320 MeV (~100% above the Coulomb barrier) has been carried out in inverse kinematics on a 0.5 mg/cm² 26Mg target at Gammasphere. This experiment is a first attempt to extend the reach of complex reactions in producing neutron-rich nuclei beyond the technique of using deep inelastic reactions on a thick target at 25% above the Coulomb barrier. The main purpose of the experiment was to explore the isotopic production of neutron-rich nuclei above doubly-magic 48Ca nucleus, as well as in the region around the target. The systematics of isotopic yields at these energies can be anticipated from Q-value arguments in the form proposed in Ref. [1]. The reaction yields will be presented. The quality of the gamma spectra from this measurement with a thin target was assessed with known isotopes. [1] A.Y. Abul-Magd et al., Phys. Lett. B 39, 166 (1973).

9:30AM FD.00006 Neutron-Rich Isotopes from 208Pb at 86 MeV/u

O.B. TARASOV, M. PORTILLO, A.M. AMTHOR, T. BAUMANN, D. BAZIN, C. FOLDEN, T. GINTER, M. HAUSMANN, D.J. MORRISSEY, J. PEREIRA, B.M. SHER MILL, M. THOENNESSEN, NSCL / MSU, C. NOCIFORO, GSI, Germany — An experiment to measure production yields from a beam of 208Pb (86 MeV/u) on Be and Ni-targets has recently been performed. The A1900 fragment-separator [1] was used to analyze products from projectile fragmentation and abrasion-fission [2]. Isotopic identification of nuclides having A ~ 200 has been achieved, demonstrating that adequate A, Z, Q resolution at this energy region is possible when using silicon detectors. The verification of PID is done via detection of multiple charge state distributions of the primary beam, as well as γ-decay of known isomers with half-lives in the microsecond range. The results demonstrate that experiments with heavy nuclei are possible on the NSCL using beams of A ~ 200. Production cross-sections have been extracted from the data that can help improve the accuracy of production models such as Abrasion-Ablation and Abrasion-Fission used in the LISE++ code [3]. The data reveal the existence of previously unreported isomeric transitions and further analysis is ongoing that may also lead to the observation of new isotopes. References: [1] D.J. Morrisey et al., Nucl. Instrum. Meth. B204 (2003) 90–96. [2] O.B. Tarasov, Tech. Rep. MSUCL1300, NSCL, Michigan St.Univ., 2005. [3] O.B. Tarasov, D. BAZIN, Nucl. Phys. A 746 (2004) 411; www.nscl.msu.edu/lise.


A. ESTRADE, NSCL, Michigan State University, and Joint Institute for Nuclear Astrophysics, M. MATOS, NSCL, and Joint Institute for Nuclear Astrophysics, A.M. AMTHOR, A. BECERRIL, T. ELLIOT, G. LORUSSO, A. ROGERS, H. SCHATZ, NSCL, Michigan State University, and Joint Institute for Nuclear Astrophysics, D. BAZIN, A. GADE, M. PORTILLO, A. STOLZ, NSCL, D. GALAVIZ, J. PEREIRA, NSCL, and Joint Institute for Nuclear Astrophysics, D. SHAPIRA, ORNL, E. SMITH, The Ohio State University, and Joint Institute for Nuclear Astrophysics, M. WALLACE, LANL — Nuclear masses of neutron rich isotopes in the region of Z ~ 20–30 have been measured using the time-of-flight technique at the National Superconducting Cyclotron Laboratory (NSCL). The masses of 5 isotopes have been measured for the first time, and the precision of several other masses has been improved. The time-of-flight technique has shown the potential to access neutron masses very far from stability when applied at radioactive beam facilities like the NSCL. Such measurements are important for understanding nuclear structure far from the valley of β-stability, and provide valuable information for astrophysical model calculations of processes involving very unstable nuclides.

9:54AM FD.00008 Development of a Versatile Array of Neutron Detectors at Low Energy

C. MATEI, Oak Ridge Associated Universities, D.W. BARDAYAN, Oak Ridge National Laboratory, J.C. BLACKMON, Louisiana State University, J.A. CISIEWSKI, W.A. PETERS, Rutgers University, R.K. GRZYWACZ, S.N. LIDDICK, S.W. PADGETT, S.D. PAIN, University of Tennessee, F. SARAZIN, Colorado School of Mines — The development of radioactive ion beams at the Holifield Radioactive Ion Beam Facility at ORNL allows the study of many neutron- and proton-rich nuclei. Proton transfer with (d,n) reactions is an excellent tool for measuring single-proton strength in neutron-rich nuclei near the Z=28 and 50 shell closures. On the proton-rich side (d,n) reactions on 56Ni and 25Al are relevant for nuclear astrophysics. We also propose measurements of beta decay properties in nuclei near 78Ni and 132Sn to determine beta decay lifetimes and branching ratios. The Versatile Array of Neutron Detectors at Low Energy (VANDLE) is a new array of plastic scintillator bars under development at ORNL. The array is highly modular allowing the configuration of the individual elements to be optimized for particular experimental requirements. We propose one configuration optimized for beta-delayed neutron emission studies and one optimized for (d,n) reactions. The scientific motivation and details of the testing and design of the array will be presented.

10:06AM FD.00009 Blurred femtoscopy in two-proton decay

C. BERTULANI, Texas A&M University - Commerce — The effects of final state interactions in two-proton emission by nuclei is discussed. The study is based on the solution the time-dependent Schroedinger equation. The relative energy between the protons is substantially influenced by the final state interactions. Alternative correlation functions can be constructed showing large sensitivity to the spin of the diproton system. The prospects of using di-proton emission as an EPR experiment is explored.

Saturday, October 25, 2008 8:30AM - 9:54AM – Session FE Nuclear Reactions: Light Ions Simmons Ballroom 1

8:30AM FE.00001 Refinement of Global Phase-Shift Analysis for p + 3 He Elastic Scattering Using Spin-Correlation Coefficients

T. DANIELS, CHARLES ARNOLD, JOHN CESARATTO, THOMAS CLEGG, ALEXANDER COUTURE, ASTRID IMIG, HUGON KAROWOSKI, University of North Carolina at Chapel Hill and Triangle Universities Nuclear Laboratory — As part of the investigation of the A=4 system, we measured the spin-correlation coefficients A_2, A_3, A_4, and A_5 for p+He elastic scattering at E_1lab of 2.3, 2.7, 4.0, and 5.5 MeV and A_2, A_3, A_4, and A_5 for p+He elastic scattering at E_1lab of 30, and 150°. The data were taken using TUNL’s atomic beam polarized ion source and our spin-exchange optical pumping polarized 3He target[1]. We aim to resolve ambiguities in the phase shifts of George and Knutson[1] which seem most sensitive to A_2 and A_5 at the lowest of these energies. Our measurements will be shown with phase-shift-analysis solutions, as well as some discussion of systematic effects related to the steering of charged particles by the target’s magnetic field.

[1] Work supported in part by USDOE grant #DE-FG02-97ER41041.
8:42AM FE.00002 Spectroscopic Factors From the Single Neutron Pickup Reaction $^{64}$Zn($\vec{d},\gamma$), KYLE LEACH, P.E. GARRETT, G.A. DEMAND, P. FINLAY, K.L. GREEN, A.A. PHILLIPS, C.S. SUMITHRARACHI, C.E. SVENSSON, S. TRIAMBÄK, University of Guelph, Canada, G.C. BALL, TRIUMF, Vancouver, Canada, T. FAESTERMANN, R. KRUCKEN, H.-F. WIRTH, Technische Universität München, Germany, R. HERTEN-BERGER, Ludwig-Maximilian-Universität München, Germany — A great deal of attention has recently been paid towards high precision superallowed $\beta$-decay $\mathcal{F}$ values. With the availability of extremely high precision (µεV) experimental data, the precision on $\mathcal{F}$ is now limited by the ∼ 1% theoretical corrections. This limitation is most evident in heavier superallowed nuclei (e.g. $^{62}$Ga) where the isospin-symmetry-breaking correction calculations become more difficult due to the truncated model space. Experimental data is needed to help constrain input parameters for these calculations, and thus experimental spectroscopic factors for these nuclei are important. Preliminary results from the single-nucleon-transfer reaction $^{64}$Zn($\vec{d},\gamma$) will be presented, and the implications for calculations of isospin-symmetry breaking in the superallowed $\beta^+$ decay of $^{62}$Ga will be discussed.

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8:54AM FE.00003 The development of single-nucleon pickup reactions with fast, exotic beams as a spectroscopic tool, S. MCDANIEL, A. GADE, P. ALDRICH, D. BAZIN, J.M. COOK, C. AA. DIGET, NSCL, Michigan State University, K.W. KEMPER, Department of Physics, Florida State University, T. GLASMACHER, A. RATKIEWICZ, K. SIWEK, NSCL, Michigan State University, J.A. TOSTEVIN, Department of Physics, University of Surrey, UK, D. WEISSHAAR, NSCL, Michigan State University — One-nucleon knockout reactions are an established tool to track the evolution of nuclear shell structure away from stability by probing single-hole states. Currently, fast-beam, heavy-ion induced pickup reactions are being developed that provide, in a similar way, the complementary structure information by probing single-particle states. At the NSCL, several proton and neutron pickup reactions centered around the proton-rich isotope $^{50}$Fe were investigated: $^9$Be($^{19}$Mn,$^{50}$Fe,$\gamma$), $^9$Be($^{50}$Fe,$^{51}$Fe,$\gamma$) and $^9$Be($^{16}$O,$^{50}$Mn,$\gamma$). Information from these reactions, including the effects of target variation ($^9$Be versus $^{12}$C), will help develop the one-nucleon pickup reaction into a tool for nuclear structure physicists.

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3Supported by the National Science Foundation.

9:06AM FE.00004 The statistical decay properties of Gadolinium isotopes using the DANCE array, D. DASHDORJ, G. MITCHELL, B. BARAMSAI, R. CHANKOVA, A. CHYZH, C. WALKER, North Carolina State University, Raleigh, NC 27695 and Triangle Universities Nuclear Laboratory, Durham, NC 27708, DANCE COLLABORATION — The gadolinium isotopes are interesting for reactor applications as well as for medicine and astrophysics. There are seven stable isotopes of gadolinium with varying deformation. Decay $\gamma$ rays following neutron capture on Gd isotopes are detected by the DANCE array, which is located at flight path 14 at the Lujan Neutron Scattering Center at Los Alamos National Laboratory. The high segmentation and close packing of the detector array enable $\gamma$-ray multiplicity measurements. The calorimetric property of the DANCE array coupled with the neutron time-of-flight technique enables one to gate on a specific resonance of a specific isotope in the time-of-flight spectrum and obtain the summed energy spectrum for that isotope. The singles $\gamma$-ray spectrum for each multiplicity can be separated by their DANCE cluster multiplicity. Various photon strength function models are used for comparison with experimentally measured DANCE data and provide insight for understanding the statistical decay properties of deformed nuclei.

9:18AM FE.00005 Determining the $(n,\gamma)$ cross section of $^{153}$Gd using surrogate reactions, NICHOLAS SCIELZO, Lawrence Livermore National Laboratory, STARS/LIBERACE COLLABORATION — The astrophysical $s$-process creates isotopes through a series of low-energy $(n,\gamma)$ reactions and beta decays. Direct measurements of the $(n,\gamma)$ cross sections for unstable nuclei are extremely challenging due to the challenges presented by radioactive targets and low intensity neutron beams. The surrogate reaction technique can be used to circumvent these difficulties by creating the same compound nucleus through light-ion reactions on a stable target. We have collected data to determine the low-energy $(n,\gamma)$ cross section for the unstable nucleus $^{153}$Gd by bombarding a stable $^{154}$Gd target with protons to create the desired $^{154}$Gd* compound nucleus. The STARS/LiberACE silicon and clover germanium detector arrays were used to detect $\gamma$-rays in coincidence with the scattered protons. Additional cross section measurements using $^{156}$Gd and $^{158}$Gd targets are compared to direct measurements of the $(n,\gamma)$ cross sections for $^{157}$Gd and $^{157}$Gd to check the technique. The current status of the analysis will be presented. Lawrence Livermore National Laboratory is operated by Lawrence Livermore National Security, LLC, for the U.S. Department of Energy, National Nuclear Security Administration under Contract DE-AC52-07NA27344.

9:30AM FE.00006 $(n,\gamma)$ by the Internal Surrogate Ratio Method: A Benchmark using $^{235}$U($d,p$), J.M. ALLMOND, University of Richmond, STARS LIBERACE COLLABORATION — The Surrogate Reaction Technique, first proposed in 1970 [1], has recently been under investigation by a Richmond / LLNL / LBNL / Yale collaboration. These studies are currently performed at LBNL using the STARS and LiBerACE detector arrays. Both absolute [1] and ratio [2] methods have been employed to circumvent technical challenges presented by the fabrication of unstable targets and by the production of high-flux neutron beams. The $^{235}$U($d,p$) surrogate reaction at 21 MeV benchmarks the $(n,\gamma)$ cross section by use of the internal ratio method (same compound nucleus but different exit channel). The present study marks the first benchmark of the internal ratio method. Previous tests of the Surrogate Ratio Method have focused on determining $(n,f)$ cross sections using the external ratio method (different compound nucleus but same exit channel). Results of this study are presented. This work was performed under the auspices of the U.S. Department of Energy under contract numbers DE-FG52-06NA26206 (UR), DE-AC02-07NA27344 (LLNL), and DE-AC02-05CH11231 (LBNL).


9:42AM FE.00007 Chemical Equilibration Involving Decaying Particles in the Early Universe, INGA KUZNETSOVA, University of Arizona, TAKESHI KODAMA, IF-UFRJ, Brazil, JÖHANN RAFELSKI, University of Arizona — We study kinetic master equations involving chemical reactions comprising the decay of particles in a thermal bath. We consider both, the decay channel into two particles, and the inverse process, the fusion of two thermal particles into one. We derive chemical equilibrium condition for the particle density. We evaluate the thermal invariant rate using as input the free space (vacuum) decay time. We consider examples, how decay time of some hadrons changes in hadronic medium, as compared to vacuum. These considerations are of interest both in heavy ion collisions applications and towards the understanding of hadron evolution in the early Universe. We consider here the reaction $^{1}$H $\rightarrow \gamma \gamma$ as one of examples.
9:06AM FF.00002 Shear Transport Coefficients from Gauge/Gravity Correspondence1, JOSEPH KAPUSTA, TODD SPRINGER, University of Minnesota — We study the shear mode in the gauge/gravity correspondence at finite temperature. First, we confirm the general formula for the shear viscosity in an arbitrary background metric which includes a black hole in the fifth dimension. We then derive a general formula for the shear mode relaxation time which appears in the theory of relativistic dissipative fluid dynamics; it agrees with known expressions in the limit of conformal fields. These results may be useful in relativistic viscous fluid descriptions of high energy nuclear collisions at RHIC and LHC.

1This work was supported by the US Department of Energy (DOE) under grant DE-FG02-88ER40388.

9:18AM FF.00003 The Lattice QCD Equation of State and Implications for Hydrodynamic Modeling of Heavy Ion Collisions1, RON SOLTZ, Lawrence Livermore National Lab, HOTQCD COLLABORATION — We present results for the QCD Equation of State of at zero baryon density calculated on a lattice of dimensions $32^3 \times 8$ with $m_1 = 0.1 m_2$ using two improved staggered fermion actions, $p_4$ and asqtad. Calculations were performed along lines of constant physics with a pion mass of approximately 200 MeV, and were carried out using more than 100M cpu-hours on BG/L supercomputers at LLNL, BNL, and UCSD. Both calculations are consistent with a cross-over transition in the range 185 – 195 MeV/c. Recent results from the lattice will be compared to those currently used as input to hydrodynamic models. Consequences for calculations of observables such as spectra, flow, and space-time measurements in heavy ion collisions will be discussed.

1Performed under the auspices of the U.S. DOE by LLNL under contract DE-AC52-07NA27344.

9:30AM FF.00004 Measurements of High $p_T$ Identified Hadron $v_2$ in Au+Au Collisions at $\sqrt{s_{NN}} = 200$ GeV by the PHENIX Experiment, SHENGLI HUANG, PHENIX Collaboration — Measurements of the elliptic flow $v_2$ at RHIC have provided sensitive information about the earliest stages dynamics of heavy ion collisions. The $v_2$ of identified hadrons has been found empirically to scale with the number of constituent quarks at low $p_T$, providing evidence that partonic degrees of freedom determine the early dynamics of the system. The measurement of high $p_T$ identified hadrons $v_2$ will allow us to further test this scaling. It will provide the information on the limits of applicability of the hydrodynamic description of the system dynamics. The difference of $v_2$ between the $K^+$, $K^-$ and the proton, anti-proton at high $p_T$ will also provide the information about the particle production and dynamics mechanism. In that the $K^+$ and anti-proton are mainly from gluon fragmentation, while the $K^+$ and proton are mainly from light quark fragmentation. In this talk, we will present measurements of pion, kaon and proton $v_2$ to $p_T$ of 6GeV/c as a function of centrality in Au + Au collisions at $\sqrt{s_{NN}} = 200$ GeV. The constituent quark scaling will be tested by these new measurements in the different centrality bins. The $v_2$ difference between the $K^+$, $K^-$ and the proton, anti-proton will also be studied as a function of $p_T$ and centrality.

10:06AM FF.00007 Unveiling properties of the QGP with Multi-Particle Correlations from the PHENIX Experiment, NUGGEHALLI AJITANAND, SUNY Stony Brook, PHENIX COLLABORATION — There is ample evidence to suggest that in heavy ion collisions at RHIC a strongly interacting state of matter resembling a near-perfect liquid (termed sQGP) is formed. It is conjectured that jet interactions can excite Mach-cone-like features in such a medium. In this study we present results of multi-particle correlations from the PHENIX experiment which are capable of discerning the presence of such exotic in-medium effects. In particular, details of three-particle correlation studies and the estimates of the sound speed that they provide, will be presented. Finally, the special case of these correlations when one of the particles is constrained by the reaction plane, will be discussed.

9:42AM FF.00005 Influence of Finite Chemical Potential on Hadronic Shear Viscosity1, NASSER DEMIR, STEFFEN A. BASS, Duke University — Ultrarelativistic heavy-ion collisions at the Relativistic Heavy-Ion Collider (RHIC) are thought to have created a Quark-Gluon-Plasma, characterized by a very small shear viscosity to entropy ratio $\eta/s$, close to the lower bound predicted for that quantity by string theory. However, due to the dynamics of the collision, the produced matter passes through a phase characterized by an expanding and rapidly cooling hadron gas with strongly increasing viscosity to entropy ratio. Such a rise in $\eta/s$ would not be compatible with the success of (viscous) hydrodynamics, which requires a very small value of $\eta/s$ throughout the full evolution of the reaction in order to successfully describe the collective flow seen in the experiments. Here we show that the inclusion of a pion chemical potential, which is bound to arise due to the separation of chemical and kinetic freeze-out during the collision evolution, will keep the value of $\eta/s$ sufficiently small to ensure the successful application of (viscous) hydrodynamics to collisions at RHIC.

1This work was supported by a DOE Outstanding Junior Investigator Award under grant number DE-FG02-03ER41239.

9:54AM FF.00006 Propagating Mach Cones in a Viscous Quark-Gluon Plasma, R. BRYON NEUFELD, Duke University — I will discuss the space-time distribution of energy and momentum deposited by a fast parton traversing a perturbative quark-gluon plasma [arXiv:0805.0385 [hep-ph]]. I use the distribution as a source term in the linearized hydrodynamical equations of the medium and present the resulting dynamics for three different values of the shear viscosity to entropy density ratio, $\eta/s$: 1/4$\pi$, 3/4$\pi$ and 6/4$\pi$. I show that well defined Mach cones are found for $\eta/s = 1/4\pi$, 3/4$\pi$ but the conical structure begins to smear out for $\eta/s = 6/4\pi$.

10:06AM FF.00007 Unveiling properties of the QGP with Multi-Particle Correlations from the PHENIX Experiment, NUGGEHALLI AJITANAND, SUNY Stony Brook, PHENIX COLLABORATION — There is ample evidence to suggest that in heavy ion collisions at RHIC a strongly interacting state of matter resembling a near-perfect liquid (termed sQGP) is formed. It is conjectured that jet interactions can excite Mach-cone-like features in such a medium. In this study we present results of multi-particle correlations from the PHENIX experiment which are capable of discerning the presence of such exotic in-medium effects. In particular, details of three-particle correlation studies and the estimates of the sound speed that they provide, will be presented. Finally, the special case of these correlations when one of the particles is constrained by the reaction plane, will be discussed.

10:18AM FF.00008 Quest for the Degrees of Freedom in sQGP: An Electric-Magnetic Duality Perspective1, JINFENG LIAO, EDWARD SHURYAK, SUNY Stony Brook — Based on monopoles and generic E-M duality, we have recently suggested a “magnetic scenario” [PRC75:054907,2007] for quark-gluon plasma in 1+1T region (known as sQGP) — a plasma in which monopoles become light, weakly coupled, and dominant d.o.f near $T_c$, while electric particles (quarks and gluons) are forced to become heavy and strongly coupled, eventually confined. This picture has been supported by several independent lattice results. In particular our “magnetic scenario” predicted that electric/magnetic effective coupling should run in opposite direction as temperature changes. This was confirmed in our paper [arXiv:0804.0255[hep-ph]] by analyzing recent accurate data about lattice monopoles. As applications of the “magnetic scenario”, we were able to show: (1) a strongly coupled plasma with equally mixed electric and magnetic charges has the desired transport properties very close to the “perfect liquid” observed at RHIC; (2) the dense monopole plasma at $T = (0.8 – 1.3) T_c$ could support metastable flux tubes between $QQ$ and allow us to explain the non-trivial $T$-dependence of the static $QQ$ potentials calculated on the lattice, see [Phys. Rev. C 77: 064905, 2008] and [arXiv:0804.4890 [hep-ph]].

1Research supported in parts by the US-DOE grant DE-FG-88ER40388

2I will change to be a postdoc at LBL by the meeting time.
8:30AM FG.00001 Exploring 3D Distributions at HERMES: Latest Results on Sivers Asymmetries and DVCS Amplitudes\textsuperscript{1}, EDWARD R. KINNEY\textsuperscript{2}. University of Colorado — The HERMES experiment is able to study two different types of “3D” observables that are related to different aspects of the Wigner distribution describing the partonic structure of the proton: transverse momentum dependent distributions (TMDs), such as the Sivers distribution, and Generalized Parton Distributions (GPDs). The former is accessed by measurement of single-spin asymmetries in semi-inclusive production of charged hadrons on a transversely polarized hydrogen target, whereas the latter are accessed, \textit{e.g.}, via the measurement of single-spin beam asymmetries in hard exclusive photon production. Both cases, interference between amplitudes results in an azimuthal dependence. For the case of TMDs, final results for the Sivers asymmetries for identified pions and charged kaons will be presented as well as results on the charged pion yield difference. For the exclusive case, new preliminary measurements of the charge asymmetry, beam spin asymmetry and the charge/beam spin interference asymmetry from hard exclusive photon production will be presented. The results are obtained from a combined analysis of polarized $e^+$ and $e^-$ beam spin asymmetries, arising from the interference of the Bethe-Heitler process with the Deeply Virtual Compton Scattering (DVCS) process.

\textsuperscript{1}On behalf of the HERMES Collaboration.

\textsuperscript{2}Supported in part by the US Department of Energy.

9:06AM FG.00002 Recent HERMES Results in Exclusive $\rho$ and $\phi$ Transverse Target Spin Asymmetries\textsuperscript{1}, STEPHEN GLISKE, WOLFGANG LORENZON, University of Michigan, HERMES COLLABORATION — Recent results from HERMES on transversely polarized hydrogen include exclusive $\pi^+$ Transverse Target Spin Asymmetries (TTSAs), as well as two moments of the L/T separated TTTSA for exclusive $\phi$ production. Fourier components of TTTSAs provide access to mostly unknown Generalized Parton Distributions (GPDs), which extend our description of the nucleon structure beyond the standard parton distributions. GPDs also allow a model-dependent extraction of the orbital angular moment of quarks in the nucleon. Both the $\pi^+$ and $\phi$ results will be presented, along with recent NLO GPD model predictions. In addition, a new unbinned method for unfolding acceptance and smearing effects will be discussed that provides increased capabilities for future measurements, \textit{e.g.} $pr$-weighted TTTSA moments and improved precision.

\textsuperscript{1}We gratefully acknowledge the support of the National Science Foundation.

9:18AM FG.00003 Measurement of the Eta Meson Transverse Single Spin Asymmetry $A_N$ at large Feynman $X_F$ with the STAR Forward Pion Detector.\textsuperscript{1}, LEN EUN, Pennsylvania State University, STAR COLLABORATION — The large values of the Transverse Single Spin Asymmetry, $A_N$, seen in forward $\pi^+$ production from polarized proton collisions have stimulated important questions and have been studied in many QCD based transverse spin models. We report the first measurement of $A_N$ for forward Eta meson production. Eta mesons of energy greater than 50 GeV ($X_F>0.5$) were observed in the STAR Forward Pion Detectors, along with $\pi^0$ mesons, at pseudorapidity of 3.65 in $\sqrt{s}=200$ GeV pp collisions. The $\pi^0$ transverse asymmetry, which has already been reported in detail by the STAR collaboration, is compared to the Eta transverse asymmetry. The current analysis suggests that in this kinematic region, the Eta asymmetry is larger than the already large $\pi^0$ asymmetry.

\textsuperscript{1}National Science Foundation PHY 05-55543

9:30AM FG.00004 Measuring the Sivers Effect via Back-to-Back Di-Hadron Correlations in the PHENIX at RHIC\textsuperscript{1}, FENG WEI, Iowa State University, PHENIX COLLABORATION — The measurement of transverse single spin asymmetries at high energies gives us an opportunity to probe the parton structure of transversely polarized nucleons. We present here an analysis of single transverse spin asymmetries using di-hadron correlations in polarized proton collisions at RHIC. We see an azimuthal asymmetry in forward-backward di-jets events. Because the PHENIX detectors at mid-rapidity cover only half of the azimuthal angle it is not possible to fully reconstruct jets. Instead, we use leading hadrons in our analysis and measure the sum of two leading back-to-back hadrons’ transverse momentum as $q_T$. We present yields of the projection of $q_T$ on the perpendicular direction to spin orientation which is the most sensitive to the small asymmetry due to Sivers effect. We will also present plans to do the same analysis using correlations of higher rapidity hadrons in the PHENIX muon arms with data collected in RHIC Run-8 which will extend the sensitivity of the asymmetry analysis to smaller parton momentum fraction.

9:42AM FG.00005 Transverse Single Spin Asymmetries in Heavy Flavor production in Polarized $p+p$ Collisions at RHIC\textsuperscript{1}, HAN LIU. Los Alamos National Laboratory, PHENIX COLLABORATION — The measurement of transverse single spin asymmetries ($A_N$) at high energies gives us an opportunity to probe the quark and gluon structure of transversely polarized nucleons. At RHIC energy, heavy flavor production is dominated by gluon-gluon fusion, so the Collins effect has minimum impact on $A_N$ as the gluon’s transversity is zero. The measurement of $A_N$ in heavy flavor production is uniquely sensitive to the gluon Sivers distribution which is related to the orbital angular momentum of gluons inside the polarized protons, thus allowing the first ever probe of the gluon’s angular momentum contribution to the proton’s spin. The PHENIX experiment has collected 2.7 pb$^{-1}$ data in transversely polarized $p+p$ collisions at $\sqrt{s}=200$GeV in 2006 run. Results for $J/\psi$ and open heavy flavor $A_N$ at forward rapidity will be presented.

\textsuperscript{1}for the PHENIX Collaboration

9:54AM FG.00006 Single transverse-spin asymmetry for $D$-meson production in semi-inclusive deep inelastic scattering\textsuperscript{1}, ZHONGBO KANG, JIANWEI QIU, Iowa State University — We study the single-transverse spin asymmetry for open charm production in the semi-inclusive lepton-hadron deep inelastic scattering. We calculate the asymmetry in terms of the QCD collinear factorization approach for $D$ mesons at high enough $P_T$, and find that the asymmetry is proportional to the twist-three tri-gluon correlation function in the proton. With a simple model for the tri-gluon correlation function, we estimate the asymmetry for both COMPASS and eRHIC kinematics, and discuss the possibilities of extracting the tri-gluon correlation function in these experiments. The SSA for open charm production in pp collision at RHIC is also discussed.

10:06AM FG.00007 Beam-Spin Asymmetry Measurements at CLAS\textsuperscript{1}, M. AGHASYAN, INFN-Frascati, CLAS COLLABORATION — The single-spin asymmetries (SSA) that have been reported recently in semi-inclusive DIS by HERMES, COMPASS and CLAS, have emerged as a powerful tool to access the orbital motion of partons. SSAs could arise in the fragmentation of polarized quarks (Collins effect) and from the interference of wavefunctions with different orbital angular momentum (Sivers effect). The two mechanisms produce different kinematical dependences and their contributions could be separated in measurements of different beam and target single-spin asymmetries. This contribution presents recent results from Jefferson Lab’s CLAS detector on beam SSAs in single neutral pion electroproduction off an unpolarized hydrogen targets in the DIS regime ($Q^2 > 16$GeV$^2$, $W^2 > 4$GeV$^2$). The measured kinematical dependences are compared with model predictions.
9:06AM FH.00004 Mass Measurements of Proton-Rich Isotopes Between Mo and Pd for rp- and νp-process Models. JENNIFER FALLIS, Manitoba / ANL, K.S. SHARMA, H. SHARMA, Manitoba, J.A. CLARK, G. SAWARD, A.F. LEVAND, T. SUN, ANL, C.M. DEIBEL, C. WREDE, Yale, A. PARIKH, Technische Universität München, D. LASCAR, R. SEGEL, Northwestern, S. CALDWELL, J. VAN SCHMITT, UTK — Time scales of explosive hydrogen burning processes are influenced by the duration of reaction cycles closed by (p,α) reactions, with breakouts occurring due to competing (p,γ) reactions. In the SiP cycle [31] (p,γ)32Cl is one such breakout reaction [1]. At novae temperatures 0.1-0.4 GK, the rate for this reaction is dominated by resonances, and thus the properties of these resonances are important in determining the reaction rate. To determine the excitation energies of the proton unbound states in 32Cl we use the Enge Spectrograph at the Yale University Wright Nuclear Structure Laboratory to measure the 32S(3He,α)32Cl charge exchange reaction. We are attempting to resolve discrepancies in the resonance energies that have been reported in previous measurements [1,2] and to measure the proton decays from these resonances. [1] S.Vouzoukas, PRC 50 (1994) 1185. [2] C. Jeanperrin, NPA 503 (1989) 77.

8:42AM FH.00002 Measurement of the 40Ca(α,γ)44Ti reaction for supernovae nucleosynthesis. STEVEN SHEETS, JASON BURKE, DARREN BLEUEL, TOM BROWN, PATRICK GRANT, ROB HOFFMAN, ERIC NORMAN, Lawrence Livermore National Laboratory, LARRY PHAIR, Lawrence Berkeley National Laboratory, NICK SCIELOZ, SCOTT TUMEY, Lawrence Livermore National Laboratory — The 40Ca(α,γ)44Ti reaction is the main production reaction for the radioactive nucleus 44Ti, which serves as an important diagnostic for understanding explosive nucleosynthesis. A new self-consistent measurement of this reaction was performed to determine the integral cross section below Eα = 5.2 MeV. An in-beam measurement using the LLNL CAMS FN tandem Van de Graaf was performed followed by a low-background counting of the activation product. A report on the progress of this experiment is given.

9:54AM FH.00003 Studying Electron-Capture on 64Zn in Supernovae with the (t,3He) Charge-Exchange Reaction1. G.W. HITT, SAM M. AUSTIN, D. BAZIN, A. GADE, C.J. GUESS, D. GALAVIZ-REDONDO, Y. SHIMBARA, C. TUR, R.G.T. ZEGERS, Michigan State University and National Superconducting Cyclotron Laboratory, M. HOROI, Central Michigan University, M.E. HOWARD, E.E. SMITH, The Ohio State University — A secondary, 115 MeV/u triton beam has been developed at NSCL for use in the (t,3He) charge-exchange(CE) reaction studies. This (n,p)-type CE reaction is useful for extracting the full Gamow-Teller (GT) response of the nucleus, overcoming Q-value restrictions present in conventional beta-decay studies. The strength (B(GT)) in 64Cu has been determined from the absolute cross section measurement of 64Zn(t,3He) near zero-degrees, exploiting an empirical proportionality between cross section and B(GT). The detailed features of the B(GT) distribution in a nucleus has an important impact on electron-capture (EC) rates in Type Ia and Core-Collapse supernovae. The measured B(GT) in 64Cu is directly compared with the results of modern shell model interactions which are used to calculate the GT contribution to EC on nuclei in supernova simulations.

1We thank NSCL operations staff and US-NSF support through grants PHY0216783 and PHY0606007.
9:42AM FH.00007 s-Process Branch Point (n,γ) Measurements using NIF* LEE BERNSTEIN, D.L. BLEUEL, C. CERJAN, LLNL, U. GREIFE, Colorado School of Mines, R.D. HOFFMAN, LLNL, L. PHAIR, LBNL, A. MCEVOY, Colorado School of Mines, K.J. MOODY, D.H.G. SCHNEIDER, D. SHAUGHNESSY, M.A. STOYER, LLNL — The National Ignition Facility (NIF) at LLNL is a laser-driven inertial confinement fusion laboratory designed to compress pellets containing small (10^20 atoms) samples of material to densities in excess of 100 g/cm^3 and temperatures up to \( T > 10^9 \) K. Early NIF shots will feature a proton-tritium (HT) fuel mix that creates a neutron spectrum similar to that found in AGB main sequence stars. In this talk I will discuss nuclear physics experiments using NIF and present a plan to measure the ^{151}Tm(n,γ)-process branch point cross section in a NIF plasma environment which will include the plasma-induced population of the first excited state at \( E_x = 50 \) Kev. This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract W-7405-Eng-48 and under Contract DE-AC52-07NA27344. For LBNL this work was supported by the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

9:54AM FH.00008 Integral Neutron Multiplicity Measurements from Cosmic Ray Interactions in Lead, THOMAS WARD, Techsource Inc., ALEXANDER RIMSKY-KORSAKOV, V.G. Khlopin Radium Institute, NIKOLAI KUDRYASHEV, V.G. Khlopin Radium Institute, DENIS BELLER, University of Nevada Las Vegas — Sixty elements \(^{1}\) He neutron multiplicity detector systems were designed, constructed and tested for use in cosmic ray experiments with a 30-cm cube lead target (306 kg). A series of measurements were performed for the cosmic ray configuration at ground level (3 meters water equivalent, mwe), in the St. Petersberg metro tunnel (185 mwe), and in the Pyhärämi mine in Finland (583 and 1185 mwe). Anomalous coincidence events with charged cosmic ray particles at sea level produced events with 100-120 neutrons due possibly to the total disintegration of the Pb nucleus. These events were also detected at 185 mwe, but the particles causing such disintegration are currently unidentified. A two layer 4charged particle coincidence/anticoincidence system has been built and integrated into the system to help identify the charge of the originating particle events. Designs for a modular 100-cm cube lead target (11.35 mmt) will be presented as well as examples of preliminary data from the various measurements and a discuss of future plans for underground experiments including possible searches for Weakly Interacting Massive Particles (WIMP, dark matter).

10:06AM FH.00009 Precision Mass Measurements of Heavy \(^{252}\)Cf Fission Fragments Near the r-Process Path\(^2\) J. VAN SCHETEL, G. SAVARD, S. CALDWELL, M. STERNBERG, Chicago, J.A. CLARK, J.P. GREENE, A.F. LEVAND, T. SUN, B.A. ZABRANSKY, ANL, J. FALLIS, K.S. SHARAF, Manitoba, D. LASCAR, R.E. SEGEL, Northwestern, G. LI, McGill — Precision mass measurements of species near the astrophysical r-process path are vital to reduce the uncertainties in the relevant neutron separation energies given by mass models, and the consequent abundance predictions. As part of an ongoing program, the Canadian Penning Trap mass spectrometer at Argonne National Laboratory is measuring the masses of fission products from a 150 \(^{252}\)Cf source placed inside a large-volume He gas catcher. New precision mass measurements have been made closer to the r-process path than have previously been published, with precisions near 15 keV/c^2. Presented measurements include Pr, Nd, Pm, Sm, Eu, and Gd to N — 96, 97, 98, 99, and 99 respectively, and our results differ from the AME 2003 by up to 515 keV/c^2. Work will continue with the current fission source until 2009, when measurements of many more neutron-rich isotopes will be made at the CARIBU upgrade to the ATLAS accelerator at ANL.

\(^1\)This work has been supported by grants from NSERC, Canada and by the U.S. DOE, Nuclear Physics Division, under Contract No. DE-AC02-06CH11357.

\(^2\)DOE grants DE-FC02-07ER41457 and DE-FC02-97ER41014.

**Saturday, October 25, 2008 10:30AM - 12:18PM**

**Session GA Quantum Phase Transitions in Atomic Nuclei and Other Finite Fermi Systems**

Simmons Ballroom 2-3

10:30AM GA.00001 Emergence of regularities and symmetries from complex nuclei, E.A. MC-CUTCHAN, Argonne National Laboratory — A challenge in studying complex many-body systems is to understand the remarkable regularities they sometimes exhibit and possibly relate these to the underlying symmetry of the system. Progress in this direction was initiated by the discovery of particular nuclei that undergo quantum phase transitions in their equilibrium phases and the development of extremely simple, analytic descriptions of nuclei at the phase transitional point in terms of critical point symmetries (CPS). Recent results inspired by the concept of CPS will be presented. Experiments aimed at identifying empirical manifestations of CPS, previously constrained to a few select regions, will be presented, covering a wider range of the nuclear chart. New observables will be discussed which not only serve as effective order parameters for identifying phase transitional behavior, but also distinguish between first and second order phase transitions. Finally, very simple and general regularities in the predictions of not only CPS, but also in other standard models, will be presented. These suggest the presence of possible underlying symmetries in a wider range of structures not limited to the critical point. This research is supported by the DOE Office of Nuclear Physics under contract DE-AC02-06CH11357.

11:06AM GA.00002 Probing Quantum Phase Changes in Nuclear Reactions\(^1\), JOSEPH NATOWITZ, Texas A&M University — Strong indications of a phase change analogous to the classical liquid gas phase transition have been observed in nuclear collisions. However the analogy should not be overstressed as nuclear matter is a strongly interacting quantum system. In the nuclear case the difference between the neutron and proton concentrations acts as an additional order parameter for which the symmetry potential is the conjugate variable. We present experimental data revealing the N/Z dependence of the nuclear phase transition and discuss possible implications in terms of the Landau Free Energy description of critical phenomena. At very low densities the clustered state is more stable than uniform matter and theoretical calculations indicate the existence of Bose Condensates and possibly self-bound bosetals or fermilets owing their existence to three-body bound states, the Efimov effect. Evidence for such behavior is also being sought in collision studies.

\(^1\)Research supported by the USD&OE and the Robert A. Welch Foundation.

11:42AM GA.00003 Thermodynamic properties and phase transitions in dilute fermion matter\(^2\), AUREL BULGAC, University of Washington — If the average interparticle distance between fermions exceeds considerably the radius of the interaction, and if the scattering length is larger than the average interparticle separation, the properties of such fermion matter become universal. Under such conditions low density neutron matter has essentially identical properties to cold atoms in traps. While the properties of such low density neutron matter cannot be studied in the lab yet, that is not the case for cold atoms. This system shares also a number of properties with the high density phase of QCD, when quarks are deconfined. From the theoretical point of view the dilute fermion system is particularly attractive, as in many cases one can aim at a full and rather accurate solution of the Schödinger equation either for the ground state or at finite temperatures, using Quantum Monte Carlo (QMC) and Density Functional Theory (DFT) techniques. This field became a beloved playing ground for many-body theorists, since many old and new techniques can be accurately validated against exact results and verified against accurate measurements. I shall present an overview of our current status of the theory, in particular what we have learned so far using QMC and DFT techniques both at zero and finite temperature, discuss the surprisingly rich phase diagram of such matter and the relevance of this new knowledge to nuclear physics and astrophysics.

\(^2\)DOE grants DE-FC02-07ER41457 and DE-FG02-97ER41014.
10:30AM GB.00001 Measuring the Anti-quark Flavor Asymmetry in the Nucleon , RUSTY TOWELL, Abilene Christian University, FNAL E906 COLLABORATION — Fermilab E866/NuSea performed the first measurements of Drell-Yan cross section ratio of p+p to p+d collisions over a large kinematic range, allowing the extraction of the ratio of anti-down to anti-up quarks in the proton. After reviewing E866 results, improvements that can be made on these measurements by taking advantage of the Fermilab Main Injector will be discussed. The lower energy of the Main Injector provides a higher Drell-Yan cross section, allowing the extension of all measurements to higher Bjorken-x with a modified spectrometer. E906 is an approved experiment that expects to make these measurements in the near future. Our goals, spectrometer design, and schedule will be presented.

10:42AM GB.00002 Exclusive $\pi^-$ Electro-production from the Neutron in the Resonance Region1, JIXIE ZHANG, Old Dominion University, CLAS COLLABORATION — The study of baryon resonances is crucial to our understanding of nucleon structure and dynamics. Although the excited states of the proton have been studied in great detail, there are very few data available for the neutron resonances because of the difficulty inherent in obtaining a free neutron target. To overcome this limitation, the spectator tagging technique was used in one of the CEBAF Large Acceptance Spectrometer(CLAS) collaboration experiments, Barely off-shell Nuclear Structure (BoNuS), in Hall-B at Jefferson Lab. We have constructed a radial time projection chamber (RTPC) based on the gaseous electron multiplier (GEM) technology to detect recoil protons with momenta from 70 to 200 MeV/c. Electron scattering data were taken in 2005 with beam energies of 2.1, 4.2 and 5.3 GeV using a 7 atm gaseous deuterium target in conjunction with the RTPC and CLAS detectors. We have analyzed exclusive $D(e,e'\pi^-p)$ events in which the proton was detected either in CLAS or in the RTPC. Preliminary cross sections will be presented for this reaction.

1Supported by a grant from the Department of Energy to Old Dominion University.

10:54AM GB.00003 Hard Photo-disintegration of proton pairs in $^3$He, ISHAY POMERANTZ, ELI PIASETZKY, Tel Aviv University, RONALD GILMAN, Rutgers University — Hard deuteron photo-disintegration has been investigated for 20 years, as its cross sections follow the constituent counting rules and it provides insight into the interplay between hadronic and quark-gluon degrees of freedom in high-momentum transfer exclusive reactions. During the summer of 2007, at Jefferson lab, Hall A, we measured for the first time hard $pp$-pair disintegration in the reaction $\gamma^*^{3}$He $\rightarrow pp + x$, using kinematics corresponding to a spectator neutron. The current state of the analysis and preliminary results will be shown. Clues to the underlying physics can be found in the comparison of our measurements with deuteron photo-disintegration, the energy dependence of the cross sections at 90° c.m., and the $\alpha_{\Delta}$ distribution.

11:06AM GB.00004 Probing Cold Dense Nuclear Matter, DOUGLAS HIGINBOTHAM, Jefferson Lab, JEFFERSON LAB HALL A COLLABORATION — The nucleons in the nucleus can form strongly correlated pairs. Recent scattering experiments, in which a proton is knocked-out from carbon with high-momentum transfer and high missing momentum, have shown that neutron-proton pairs are nearly 20 times as prevalent as proton-proton and, by inference, neutron-neutron pairs. This result, which is due to tensor correlations, has implications for our understanding of nuclear systems from nuclei to neutron stars.

11:18AM GB.00005 A measurement of the nuclear dependence of hadronization of neutral kaons1, AJI DANIEL, Ohio University, CLAS COLLABORATION — Understanding the confinement of quarks and gluons in hadrons is one of the great challenges in hadronic physics. Semi-inclusive measurements of deep inelastic electron scattering from nuclei provide a unique testing ground to study the process of hadron formation. The space-time features and the nuclear dependence of quark propagation and hadronization can be extracted by comparing the production of various hadronic species from a number of target nuclei under different kinematic conditions. I will present preliminary results on the multiplicity ratios of $K^0$ as a function of $z(=\frac{E_z}{E})$ and $P_T^2$ from Jefferson Lab experiment E02-104. The CLAS large acceptance detector, with an electron beam of energy 5 GeV, was used to study the nuclear dependence of neutral kaon production. Data on multiplicity ratios of kaons with strangeness will provide further input for theories of hadronization, inspired by dynamical models of QCD.

1Work supported in part by NSF PHY-0653454.

11:30AM GB.00006 Impulse Approximation limitations to the $(e,e')p$ reaction on $^{208}$Pb and $^{12}$C: extracting spectroscopic factors as a function of $Q^2$ , JOAQUIN LOPEZ HERRAIZ, Universidad Complutense de Madrid, Madrid, Spain, JUAN CARLOS CORNEJO, California State University, Los Angeles, JEFFERSON HALL A COLLABORATION — Experiment E06007 at Jefferson Lab measured cross sections for the $(e,e')p$ reaction at constant $(q, \omega)$ for $Q^2 = 0.81$ GeV$^2$ over a wide range of missing momenta. At missing momentum $p_m = 0$ MeV/c cross sections were also measured at $Q^2 = 1.4$ GeV$^2$ and $1.97$ GeV$^2$ in order to investigate a possible dependence of the spectroscopic factor on $Q^2$ suggested by previous measurements. Comparison of the experimental results to theoretical predictions will be presented.

11:42AM GB.00007 Impulse Approximation limitations to the $(e,e')p$ reaction on $^{208}$Pb: identifying relativistic effects in the nuclear medium via $A_{T\perp}$ measurements, ALEXANDRE CAMSONNE, Jefferson National Accelerator Facility, Newport News, VA, JUAN CARLOS CORNEJO, California State University, Los Angeles, JOAQUIN LOPEZ HERRAIZ, Universidad Complutense de Madrid, Madrid, Spain, JEFFERSON HALL, HALL A COLLABORATION — Experiment E06007 at Jefferson Lab measured cross sections for the $(e,e')p$ reaction at constant $(q, \omega)$ for $Q^2 = 0.81$ GeV$^2$ over a range of missing momenta from 0 to $\pm$ 500 MeV/c. A controversial issue over the last decades has been the role of relativity in the description of nuclei. A distinctive signature of dynamical relativistic effects in the nuclear wave function is the asymmetry, $A_{T\perp}$ in the cross section measured forward or backward of the three momentum transfer $q$. Results for the integrated cross sections for producing the low lying states of $^{207}$Tl for both positive and negative missing momenta will be presented and compared to relativistic and nonrelativistic theoretical predictions.
11:54AM GB.00008 Impulse Approximation limitations to the \((e,e'p)\) reaction on \(^{208}\text{Pb}\): identifying correlations in the nuclear medium. JUAN CARLOS CORNEJO, California State University, Los Angeles, JOAQUIN LOPEZ HERRÁIZ, Universidad Complutense de Madrid, Madrid, Spain, JEFFERSON LAB HALL A COLLABORATION — Experiment E06007 at Jefferson Lab measured cross sections for the \((e,e'p)\) reaction at constant \((q^2)\) for \(Q^2 = 0.81 \text{ GeV}^2\) over a range of missing momenta from 0 to 500 \text{ MeV/c}. Spectroscopic factors for states near the Fermi level are typically in the range of 0.65-0.70, a feature usually attributable to correlations. A consistent description of nuclear structure requires that these correlations should also have a significant effect on the strength of high momentum components of single nucleon states. Cross sections for missing momenta from 300 \text{ MeV/c} to 500 \text{ MeV/c} for the \(^{208}\text{Pb}(e,e'p)\) reaction going to the low lying states of \(^{207}\text{Tl}\) will be presented and compared to theoretical predictions using various prescriptions for including correlations.

12:06PM GB.00009 Results of PrimEx Experiment\(^1\), PAWEL AMBROZEWICZ, North Carolina A&T State University, PRIMEX COLLABORATION — A precision measurement of neutral pion lifetime was carried out at the Jefferson Lab - the PrimEx experiment. The measurement probed one of the most fundamental symmetry predictions of low energy Quantum Chromodynamics, the chiral anomaly, via the Primakoff effect, coherent \(\pi^0\) production off a nuclear Coulomb field. The calculation of the \(\pi^0\) radiative width, obtained using the transition amplitude in the chiral limit, yields 7.725 eV. Next-to-leading order calculation of this quantity, in the framework of Chiral Perturbation Theory, gives 8.1 eV \pm 1.0% while the calculation in the QCD Sum Rule regime results in 7.93 eV \pm 1.5%. Data were collected, for \(^{12}\text{C}\) and \(^{208}\text{Pb}\) targets, and covered a range of photon energies and angles that allowed clean separation of the Primakoff contribution from competing photoproduction processes. The validity of the measurement is confirmed by concurrent cross section measurements for two other electromagnetic processes, \(e^+e^-\) pair production and Compton scattering. The result approaches the precision mentioned in recent theoretical calculations. Thus the measurement of the \(\pi^0\) radiative decay width, or in turn \(\pi^0\) lifetime, provides a stringent test of this theory prediction. Results will be presented.

\(^1\)Experiment was in part supported by NSF MRI PHY 0079840 grant.

Saturday, October 25, 2008 10:30AM - 12:06PM –
Session GC Mini-Symposium: Neutrino Properties and Nuclear Physics IV  
Jewett Ballroom A-B

10:30AM GC.00001 Sterile Neutrino Dark matter. CHAD KISHIMOTO, GEORGE FULLER, UC San Diego — We discuss medium-enhanced, neutrino scattering-induced production of dark matter candidate sterile neutrinos in the early universe. We compare a complete quantum kinetic equation treatment with the widely used quantum Zeno ansatz. We discuss the resultant sterile neutrino energy spectra and the role these may play in obtaining astrophysical constraints on these dark matter candidates.

10:42AM GC.00002 Heavy Sterile Neutrinos, Primordial Nucleosynthesis, and the Evolution of the Early Universe. CHRISTEL SMITH, GEORGE FULLER, CHAD KISHIMOTO, University of California, San Diego, ALEXANDER KUSENKO, KALLOIPIO PETRAKI, University of California, Los Angeles — We examine the effect on the evolution of the early universe and on the Big Bang Nucleosynthesis (BBN) process of massive sterile neutrinos (rest masses \(\sim 20-100\) eV) which mix in vacuum with ordinary active neutrinos. We find that light element BBN considerations can provide probes of this sector of neutrino physics which are complementary to or even extend those based on laboratory measurements.

10:54AM GC.00003 Search for Sterile Neutrinos at the SNS: OscSNS. WILLIAM LOUIS, LANL, OSCNS COLLABORATION — The SNS is coming online over the next few years and will be a prodigious source of neutrinos from \(\pi^+\) and \(\mu^+\) decay at rest, which can be used for high-precision neutrino oscillation experiments. The neutrino flux from the SNS is known extremely well and includes \(\nu_{\mu}\) and \(\nu_{\tau}\) from \(\mu^+\) decay at rest, as well as the 30 MeV monoenergetic \(\nu_{\mu}\) from \(\pi^+\) decay at rest that can be used to search for the existence of sterile neutrinos via the neutral-current reaction \(\nu_{\nu'}C\rightarrow \nu_{\nu'}C\) (15.11). An oscillation or suppression of this reaction would be direct evidence for sterile neutrinos. The OscSNS detector is based on the LSND and MiniBooNE detectors and can achieve the world’s best neutrino oscillation sensitivities for \(\nu_{\mu}\rightarrow \nu_{e}\) oscillations, \(\nu_{\mu}\rightarrow \nu_{\tau}\) oscillations, and \(\nu_{\mu}\rightarrow \nu_{e}\) oscillations at a \(\Delta m^2\) scale of \(\sim 1 \text{ eV}^2\). In addition, OscSNS can make precision measurements of \(\nu_{\mu}e\rightarrow \nu_{\mu}e\) elastic scattering, \(\nu_{\tau}e\rightarrow \nu_{\tau}e\) elastic scattering, and \(\nu_{\nu'}C\rightarrow e^-N\) charged-current scattering.

11:06AM GC.00004 Measuring Atmospheric Neutrinos at the Sudbury Neutrino Observatory. THOMAS WALKER, Massachusetts Institute of Technology, SUDBURY NEUTRINO OBSERVATORY COLLABORATION — While the Sudbury Neutrino Observatory was designed to detect low energy solar neutrinos, it can also track high energy muons from cosmic ray showers and atmospheric neutrino interactions. Because of SNO’s great depth and flat overburden, the cosmic ray muon flux is negligible unless the muons are traveling at a relatively steep angle (zenith angle less than 66 degrees). This means that neutrino-induced muons can be observed both above and below the horizon. The neutrinos from below the horizon will have undergone oscillations, while the neutrinos from above will not. This unique sample of unoscillated neutrinos will allow SNO to constrain the flux of high energy atmospheric neutrinos in addition to extracting oscillation parameters. This talk will describe SNO’s measurements of the atmospheric muon neutrino flux, oscillation parameters, and the flux of cosmic ray muons at a depth of 6000 meters water equivalent using the entire SNO dataset.

11:18AM GC.00005 Neutrino Interactions in MiniBooNE. CHRIS POLLY, University of Illinois at Urbana-Champaign, MINIBOONE COLLABORATION — The MiniBooNE experiment at Fermilab has amasses an unprecedented number of neutrino and antineutrino interactions in the 1 GeV \(E_r\) range. Ongoing analyses in both charged and neutral-current sectors continue to make progress, particularly in understanding (quasi)elastic and single pion production channels. In addition to 6.5E20 protons on target (POT) acquired with a neutrino beam, MiniBooNE has now also collected 3e20 POT in antineutrino mode. An overview of cross-sections in MiniBooNE with an emphasis on more recent results will be given.

11:30AM GC.00006 Improved Description of Charged Current Pion Production in the MiniBooNE Detector. JAROSLAW NOWAK, Louisiana State University, MINIBOONE COLLABORATION — The MiniBooNE experiment has collected an enormous sample of about 46k events of positive pions production via the charged current (CCPiP). The purity of the CCPiP sample is at a level of 87% and it the purest sample observed in the MiniBooNE detector. The average neutrino energy in the MiniBooNE beam is about 700 MeV, which gives us an opportunity of doing detail study of the resonant and coherent pion production. A long-standing problem of a discrepancy of the CCPiP production as a function of the four-momentum transfer and scattering angle between Monte Carlo prediction and observed events will be discussed. The attempts to address this problem will be presented. The Rein-Sehgal model of the resonant and coherent production has been extended to include the muon mass in the final state. Also a new form of the vector and axial vector form factor were used.
Los Alamos National Laboratory, MINIBOONE COLLABORATION — The MiniBooNE experiment was designed to test the results from the LSND experiment which saw evidence for $\bar{\nu}_e \rightarrow \bar{\nu}_\mu$ oscillations at $\Delta m^2 \sim 1 \text{ eV}^2$. The LSND signal cannot be reconciled with neutrino oscillations observed with solar and atmospheric neutrinos within the framework of three Standard Model neutrinos. Previously MiniBooNE looked for the appearance of electron neutrinos in a $\nu_\mu$ beam but saw no evidence for oscillations. Currently MiniBooNE is taking data using the $\nu_\mu$ beam. This talk presents the status of the oscillation analysis using anti-neutrino data.

11:54AM GC.00008 Pion LINAC as an Energy-Tagged Neutrino Source

TERRY GOLDMAN, RICHARD SILBAR, Los Alamos National Laboratory — The energy spectrum and flux of neutrinos from a linear pion accelerator are calculated analytically under the assumption of a uniform accelerating gradient. The energy of a neutrino from this source reacting in a detector can be determined from timing and event position information.

Saturday, October 25, 2008 10:30AM - 12:18PM

Session GD Mini-Symposium: Cold Nuclear Matter and Low-x Physics at RHIC

10:30AM GD.00001 Physics of strong color fields at RHIC

DMITRI KHARZEEV, Brookhaven National Laboratory — Nuclear collisions at RHIC provide a unique window into the properties of strong color fields. I will review the current state of knowledge about the nuclear wave functions at small Bjorken $x$ and the early moments of nuclear collisions with an emphasis on theory predictions for various experimental observables in Deuteron - Gold collisions.

11:06AM GD.00002 Charmonium production and absorption in proton-nucleus collisions

CARLOS LOURENCO, CERN, RAMONA VOGT, LNL, HERMINE WOHRI, LIP — The $J/\psi$, $\psi'$ and $\chi_c$ yields are expected to be considerably suppressed if a deconfined medium is formed in high-energy heavy-ion collisions. However, already in p+A collisions the charmonium production cross sections scale less than linearly with the number of binary $N\bar{N}$ collisions. This “normal nuclear absorption” must be accounted for before signals of the QCD medium can be identified in the $A_0$ measurements. We compare the $J/\psi$ and $\psi'$ production in fixed-target $p\A$ interactions (200 $< E_{\text{lab}} <$ 920 GeV) and in d+Au collisions at RHIC ($\sqrt{s} = 200$ GeV) with Glauber calculations using several sets of parton densities. We find a significant energy dependence of the mid-rapidity charmonium “absorption cross sections”, indicating stronger nuclear absorption than previously assumed at $E_{\text{lab}} = 158$ GeV, the CERN SPS lead beam energy. We also show that the absorption depends on the charmonium rapidity, even close to mid-rapidity. These new findings indicate stronger nuclear absorption than previously estimated from the SPS heavy-ion data.

11:18AM GD.00003 Charmonium Cold Nuclear matter effects: Unraveling a unique signature of the QGP

LOREN LINDEN LEVY, University of Colorado. PHENIX COLLABORATION — Charmonium suppression in hot and dense nuclear matter has been touted as an unique signature for the production of deconfined QCD matter. In order to search for this effect one must have a clear understanding of the modifications present in the charmonium spectrum resulting from the interaction with normal cold nuclear matter. The PHENIX collaboration has measured $J/\psi$ spectrum from deuteron-gold (d-Au) interactions at $\sqrt{s} = 200$GeV and compared these with a proton-proton baseline in order to constrain these cold nuclear matter effects. We will present the latest analysis from RHIC Run-8, with an integrated luminosity of 80 nb$^{-1}$, compared to the 2.4 nb$^{-1}$ collected in RHIC Run-3.

11:30AM GD.00004 $J/\psi$ Measurements in A+A Collisions at PHENIX

MATTHEW WYSOCKI, University of Colorado, PHENIX COLLABORATION — $J/\psi$ production in A+A collisions is expected to be an important probe of the produced medium. Suppression due to color-charged screening was long expected to be a smoking gun for the quark-gluon plasma. However, in recent years a more complex picture of in-medium charmonium production and evolution has emerged, including cold nuclear matter (CNM) effects and enhancement from recombination of $c$-$\bar{c}$ pairs. At the same time, new experimental results that extend our reach in $p_T$ and new observables such as $\Delta y$ will allow us to better constrain theoretical models. The most recent $J/\psi$ results in $\sqrt{s_{NN}}=200$ GeV A+A collisions from the PHENIX experiment will be presented. By measuring these observables as functions of transverse momentum and rapidity PHENIX hopes to put quantitative constraints on the various effects that contribute to charmonium suppression in hot and dense QCD matter.

11:42AM GD.00005 Transverse energy in ultra-relativistic heavy ion collisions with the PHENIX MPC

BRETT FADEM, Muhlenberg College. PHENIX COLLABORATION — The muon piston calorimeter (MPC), one of the detector upgrades to the PHENIX experiment, has only been in place since 2006. Consisting of two stations, North and South, the MPC significantly extends PHENIX’s kinematic acceptance into the range $3.1 < |y| < 3.8$. In 2007, $\sqrt{s} = 200$ GeV Au+Au collisions were produced at RHIC. Progress in measuring the transverse energy in the forward region of these collisions using the MPC will be discussed.

11:54AM GD.00006 Are direct photons suppressed at high $p_T$ in relativistic heavy ion collisions?

GABOR DAVID, Brookhaven National Laboratory. PHENIX COLLABORATION — Preliminary results from PHENIX on direct photon production in 200GeV Au+Au collisions indicated that while at moderate $p_T$ (4-14GeV/c) the nuclear modification factor for photons is unity, at higher $p_T$ it may be significantly less, maybe even similar to the well-established hadron-suppression (“jet quenching”). Such suppression might have both trivial reasons (“isospin effect”) and be the consequence of genuine nuclear effects. On the other hand this $p_T$ region is very challenging experimentally. Applying the latest analysis techniques to the 200GeV and 62GeV Au+Au data from PHENIX we will investigate if direct photons are suppressed at high $p_T$ and if so, what are the physics implications.
Nuclear Resonance Fluorescence States in $^{239}$Pu. The measurements were performed at the HVRL at MIT using a bremsstrahlung source with an endpoint energy up to 3 MeV. Plans for future measurements of NRF states in $^{239}$Pu at higher energies will be presented. We will also briefly discuss current research at LLNL to use NRF as a method to isotopically map containers.

1Part of this work was done in collaboration with Passport Systems Inc. This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.
11:30AM GE.00006 Decay Study of $^{257}\text{Rf}$

J. QIAN, A. HEINZ, R. WINKLER, Yale Univ., R.V.F. JANSSENS, T.L. KHOW, D. SEWERYNIK, B.B. BACK, M.P. CARPENTER, A.A. HECHT, C.L. JIANG, F.G. KONDEV, T. LAURITSEN, C.J. LISTER, D. PETERSON, A. ROBINSON, G. SAVARD, X. WANG, S. ZHU, ANL, A.B. GANSWORTHY, Surrey Univ., M. ASAI, Japan Atomic Energy Agency — Excited states in heavy odd-even nuclei allow for the measurement of single-particle energies of orbitals playing a major role in the shell stabilization of superheavy nuclei. In this work we report on decay spectroscopy of $^{257}\text{Rf}$. The excited states of $^{257}\text{Rf}$ and its daughter $^{253}\text{No}$ can provide information on the single-particle structure near the deformed neutron shell $N=152$. $^{257}\text{Rf}$ was produced in the fusion-evaporation reaction $^{50}\text{Ti}+^{208}\text{Pb}$ at the Argonne Tandem Linac Accelerator System, using the Fragment Mass Analyzer. The mass/charge ratio of the recoils was used for the identification of the evaporation residues. The $\alpha$ decays and internal conversion electrons from $^{257}\text{Rf}$ or its decay products were recorded in a Double-sided Silicon Strip Detector and the gamma rays coincident with the charged particles were detected in four HPGe detectors. The results are compared with those of $N=153$ isotones and analyzed in a theoretical Macroscopic-Microscopic framework using the universal Woods-Saxon single-particle potential. These data can test the validity of this potential for superheavy nuclei. This work was supported by the U.S. DOE under contract No. DE-AC02-06CH11357 and DE-FG02-91ER40609.

11:42AM GE.00007 Nuclear Spin Cut-off Parameter Deduced from Average Level Spacing

A.N. BEHKAMI, Physics Department of Fars Science and Research Center, Islamic Azad University, MEHRDAD GHOLAMI, Chemistry Department of Marvdasht Islamic Azad University — Nuclear spin cut-off parameters have been investigated for a large range of nuclear mass from the knowledge of nuclear level density at neutron binding energy, $B_n$, and average S-wave neutron spacing $<D_{1/2}>$, which is $<2\sqrt{<2(B_n)>}$. Nuclear level densities at neutron binding energy have been computed using microscopic approach. The average S-wave level spacing were taken from various compilations. The deduced values of spin cut-off parameters from the above expression have been compared with their corresponding newly published results obtained on the basis of the BCS Hamiltonian. It is found that our results are much lower than their corresponding values obtained on the basis of microscopic calculations. However, it is shown that if the values of the spin cut-off parameter deduced from the average level spacing are multiplied by a factor, $F=0.25[Z/(Z+N)+1]$, the agreement between the two sets becomes satisfactory. The results from both approaches will be presented and compared. The overall trends obtained from different approaches will be discussed.

11:54AM GE.00008 Formation of a new state of nuclear matter in nuclear fission

GENEVIEVE MOUZE, SABET HACHEM, CHRISTIAN YTHIER, Facult´ e des Sciences, Universit´ e de Nice — The mass distributions of asymmetric and symmetric fission of actinide nuclei can be explained. Fissile nuclei are internally clustered into a $^{208}\text{Pb}$-like core and a cluster made of its valence nucleons. If the energy released by the dissociation is great enough, the superficial nucleons of the core can be transferred to the cluster in a kind of internal collision, occurring within $1.8 \times 10^{-25}$s as can be demonstrated. This collision creates extreme conditions, and a new nucleon phase replaces the normal proton- and neutron-phases, but conserves their organization law. The transferred nucleons are statistically distributed between the valence shells of an $A_{\text{tot}}=126$ nucleon core and those of an $A_{\text{L}}=82$ nucleon core (or of an $A_{\text{L}}=126$ nucleon core in symmetric fission), with a distribution coefficient of 0.206. The closure of the $A_{\text{L}}=126$ nucleon shell separates the regions of asymmetric and symmetric fission. The great yield of the symmetric mode results from the appearance of fragment-pair $Q_{\text{tot}}$-values greater than their own Coulomb barrier, i.e. from barrier-free fission.

12:06PM GE.00009 The concept of barrier in nuclear fission

GENEVIEVE MOUZE, CHRISTIAN YTHIER, Université de Nice, 06108 Nice cedex 2, France — An internal fission barrier can exist in a heavy nucleus if its internal energy, resulting from its internal dissociation into a dinucleus system, is not great enough for inducing a rearrangement into fragment pairs. But there exists also an external fission barrier, which is defined for a fission into a given pair $\gamma$. The study of $^{258}\text{Fm}$ (s.f.) has shown that $B_{\gamma}^{(i)}$, equal to $B_{\gamma}^{(i)} - Q_{\text{tot}}^{(i)}$, i.e. to the difference between Coulomb barrier and fission energy of the pair $\gamma$, is still negative, after sphericity correction, for its most energy-rich pairs $^{132}\text{Sn}-^{110}\text{Sn}$ and $^{132}\text{Sn}-^{132}\text{Sn}$; this explains the considerable fission yield of $^{258}\text{Fm}$ at $A \sim 129$. For the system $^{235}\text{U}+\text{n}_{\text{th}}$, the $B_{\gamma}^{(i)}$ are positive for all possible fragment pairs, since $B_{\gamma}^{(i)}$ is already positive, and equal to 2.73 MeV, for the most energy-rich pair $^{132}\text{Sn}-^{110}\text{Mo}$; but a sphericity correction of about 3 MeV is necessary for the presence of the thin nucleus: this suggests that the reported value of 5.80 MeV of the “fission barrier” of $^{235}\text{U}+\text{n}_{\text{th}}$ is nothing else but its smallest external fission barrier, after sphericity correction.

Saturday, October 25, 2008 10:30AM - 12:18PM –

Session GE.00001 Precision Determination of the Excitation Energy of the Long-Lived Isomer in the Superallowed Fermi Emitter $^{42}\text{Sc}$

M. STERNBERG, G. SAVARD, Chicago, J. CLARK, I. TANIHATA, N. SCIELZO, A.F. LEVAND, Y. WANG, H. SHARMA, A. HECHT, A.C.C. VILLARI, J. FALLIS, ANL, R. SEGEL, Northwestern, A. HEINZ, V. WERNER, J.R. TERRY, Yale, E.A. MCCUTCHAN, Yalw, H. AI, B. SHORAKA, E. WILLIAMS, R. LUTTKE, D. FRANK, C.W. BEAUSANG, Yale, P. REGEN, Surrey, K.S. SHARMA, Manitoba — Some Q-value measurements for superallowed Fermi emitters used in calculation of the $\nu_{\text{ud}}$ quark mixing matrix element came into question after measurements at ANL and confirmation of these measurements by JYFLTRAP found the Q-value for $^{134}\text{Te}$ to differ by more than 2 keV ($7\sigma$) from the previous accepted value. A new precision Q-value measurement for the superallowed emitter $^{42}\text{Sc}$ performed by JYFLTRAP found no substantial shift from the previous accepted Q-value. Their measurement included a new precision measurement of the excitation energy of the 7.5 long-lived isomeric state of $^{42}\text{Sc}$, which did not agree with old measurements. New measurements of this excited state have been preformed at YRASTBall to within roughly 200 eV. Combined with recent measurements for the mass of this excited state preformed by the Canadian Penning Trap Group of ANL, a new precision Q-value measurement has been completed and no substantial shift in the $^{42}\text{Sc}$ Q-value is observed.

10:42AM GF.00002 Precise Half Life Measurement of $^{26}\text{Si}$

V.E. IACOB, V. GOLOVKO, J. GOODWIN, J.C. HARDY, N. NICA, H.I. PARK, L. TRACHE, R.E. TRIBBLE, Cyclotron Institute at Texas A&M University — As part of our program to test the unitarity of the Cabibbo-Kobayashi-Maskawa (CKM) matrix via $0^+ \rightarrow 0^-$ superallowed $\beta$ transitions, we recently measured the half-life of $^{26}\text{Si}$. The radioactive $^{26}\text{Si}$ beam was obtained with a 27$\text{Al}$ primary beam at 30.1 MeV, which bombarded a cryogenic hydrogen target held at a pressure of 2.0 atm. From the reaction products, a high-purity $^{26}\text{Si}$ beam at 25.1 MeV was selected with the MARS spectograph. The beam was then extracted in air, passed through a 0.3-mm-thick BC-404 plastic scintillator and a set of Al degraders, which had been adjusted so that the radioactive nuclei stopped in the center of the 76-mm-thick aluminium-mylar tape of our fast tape-transport system. We collected $^{26}\text{Si}$ nuclei for 1.3 s; then the beam was switched off and the activity was moved in less than 0.2 s to the center of a $4\pi$ proportional counter, located in a well-shielded region. The observed decays were then multi-scaled over a 44 s time span. To ensure an unbiased result, we split the experiment into many runs, each differing from the others in its discriminator threshold, detector bias or dominant dead-time setting. The analysis of these separate runs showed no systematic bias with these parameters. Our preliminary result agrees with the currently accepted (average) value, and the full analysis is expected to yield an uncertainty of 0.05% or better.
10:54AM GF.00003 Search for Oscillation of the Electron-Capture Decay Probability of $^{142}\text{Pm}$

PAUL VETTER, R.M. CLARK, J. DVORAK, S.J. FREEDMAN, K.E. GREGORICH, H.B. JEPPESEN, D. MITTELBERGER, Lawrence Berkeley National Laboratory, M. WIEDEKING, Lawrence Livermore National Laboratory — We have searched for time modulation of the electron capture decay probability of $^{142}\text{Pm}$ in an attempt to confirm a claim from a group at the Gesellschaft für Schwerionenforschung (GSI) attributed to neutrino oscillation. We produced $^{142}\text{Pm}$ via the $^{124}\text{Sn}(^{3}\text{He}, 5\nu)^{142}\text{Pm}$ reaction at the Berkeley 88-Inch Cyclotron with a short bombardment time. Isotope selection by the Berkeley Gas-filled Separator is followed by implantation and a long period of monitoring the $^{142}\text{Nd K}_{\alpha}$ x-rays from the daughter. The decay time spectrum of the x-rays is well-described by a simple exponential and our measured half-life is consistent with the accepted value. We observed no decay rate oscillation at the frequency reported by Litvinov et al. (Phys. Lett. B 664, 162 (2008)), and no oscillation terms at any frequency were statistically significant. A search for previous experiments that might have been sensitive to the reported modulation uncovered another example in $^{142}\text{Eu}$ electron-capture decay. A reanalysis of the published data shows no decay rate oscillation.

1Supported by the U.S. Department of Energy under Contract Nos. DE-AC02-05CH11231 and DE-AC52-07NA27344.

11:06AM GF.00004 Central Particle Tracking Detectors in the PEN Experiment

EMIL FRELEZ, University of Virginia, PEN COLLABORATION — The PEN Collaboration is conducting a new measurement of the $\pi^{+} \rightarrow e^{+}\nu(\gamma)$ ($\pi_{e2}$ decay) branching ratio at the Paul Scherrer Institute, with the goal uncertainty of $\Delta B/B \approx 5 \times 10^{-4}$ or lower. At present, the combined accuracy of all published $\pi_{e2}$ decay measurements lags behind the theoretical calculation by a factor of 40. In this contribution we describe the redesigned central region tracking detectors of the PEN detector. The design and performance of a pair of two-piece wedge degraders for simultaneous horizontal and vertical tracking of the $\pi^{+}$ beam is presented in detail. After passing through the tracking degrader, the $\pi^{+}$ beam is stopped in the center of an active target scintillator. The positions from $\pi^{+}$ and $\mu^{+}$ decays are tracked in a pair of cylindrical MWPC’s, and detected in a thin plastic scintillator hodoscope and a pure CsI electromagnetic calorimeter.

1Supported by US NSF, PSI, and JINR Dubna

11:18AM GF.00005 Waveform Analysis for a Precision Pion Decay Measurement

ANTHONY PALLADINO, University of Virginia, PEN COLLABORATION — The PEN experiment aims to measure the $\pi^{+} \rightarrow e^{+}\nu(\gamma)$ ($\pi_{e2}$ decay) branching ratio at PSI, with an uncertainty of $\Delta B/B \approx 5 \times 10^{-4}$, or better, using a large-angle detector system featuring a pure CsI calorimeter. A critical element of the data analysis requires distinguishing $\pi \rightarrow e\nu$ events from the $\pi \rightarrow \mu \rightarrow e$ decay chain. A digitized waveform for a large subset of pion decay events must be reliably sorted into one of the two categories in order to reveal the low-energy “tail” of the calorimeter response to the $\pi_{e2}$ 69 MeV $e^{+}\nu$'s otherwise masked by the muon decay positrons. Most events contain pulses which overlap. An analysis program was designed to distinguish between the different decay types with a high resolution extraction of closely spaced peaks. The peak to peak (or overlapping pulse) separation methods and their relative merits will be discussed.

11:30AM GF.00006 Prospects for a High Sensitivity Lepton Flavor-Violating Search at Fermilab

JAMES MILLER, Boston University — The Mu2e collaboration is proposing to search for coherent, neutrino-less conversion of muons into electrons in the field of a nucleus, with a sensitivity improvement of a factor of 10,000 over existing limits. Such a lepton flavor-violating reaction probes new physics at a scale unavailable by direct searches at either present or planned high energy colliders. The physics motivation for mu2e will be presented, as well as the design of the muon beamline and spectrometer. A scheme by which the experiment can be mounted in the present Fermilab accelerator complex will be described. Prospects for increased sensitivity from the Project X linac that is being proposed by Fermilab will be discussed.

1on behalf of the Mu2e Collaboration

11:42AM GF.00007 Muon radiative decay and limits on non-($V-A$) weak interaction

MAXIM BYCHKOV, University of Virginia, PIBETA/PEN COLLABORATION — Using the PIBETA detector in its original form and, more recently, as configured for the PEN experiment, we have recorded the world largest sample of radiative muon decay events $\mu^{+} \rightarrow e^{+}\nu\gamma$, resulting from secondary muons produced by a stopped pion beam. Theoretical predictions of the muon radiative decay branching ratio depend on the Michel parameters $\rho$ and $\Upsilon$ which, along with other muon decay parameters, can be used to set limits on the possible extensions of the $V-A$ form of the electroweak interactions. We will report the branching ratio for this process in a wide kinematic region of phase space, and a new, improved value of the parameter $\langle\text{eta-bar}\rangle$, which, coupled with other results, provide comprehensive limits on non-standard contributions to the electroweak interaction.

11:54AM GF.00008 Future Prospects for a Muon g-2 Experiment

DAVID HERTZOG, CHRIS POLLY, University of Illinois at Urbana-Champaign, NEW MUON G-2 COLLABORATION — The final results from the muon g-2 experiment at Brookhaven National Laboratory were published in 2004. The difference between the final experimental result and the current theoretical prediction for $a_{\mu}$ reveals a 3.4\sigma discrepancy with the Standard Model, hinting at the possibility of new particles entering via quantum fluctuations. The experiment ended in a statistical error dominated regime, thus enabling a future generation muon g-2 experiment to be pursued with a higher muon flux and relatively minor modifications to the basic technique. The motivation for a new experiment will be discussed along with a description of design improvements and siting considerations for a new effort at BNL, FNAL, or JPARC.

12:06PM GF.00009 Isospin-symmetry-breaking corrections to superallowed Fermi beta decay

GERALD A. MILLER, Univ. of Washington, ACHIM SCHWENK, TRIUMF — We study the formalism to include isospin-symmetry-breaking corrections when extracting the up-down Cabibbo-Kobayashi-Maskawa matrix element from superallowed $0^{+} \rightarrow 0^{+}$ nuclear beta decay. We show that there are no first order isospin-symmetry-breaking corrections to the relevant nuclear matrix elements. We find corrections to the treatment of Towner and Hardy, and assess these using schematic models of increasing complexity.
10:30AM GG.00001 The neutron’s negative central charge density: the inclusive-exclusive connection1, GERALD A. MILLER, Physics Department, University of Washington — Models of generalized parton distributions at zero skewness are used to relate the behavior of deep inelastic scattering quark distributions, evaluated at high $x_s$, to the transverse charge density evaluated at small distances. We obtain an interpretation of the recently obtained negative central charge density of the neutron. The $d$ quarks dominate the neutron structure function for large values of Bjorken $x$, where the large momentum of the struck quark has a significant impact on determining the center of momentum, and thus the “center” of the nucleon in the transverse position plane.

1In collaboration with John R. Arrington, Physics Division, Argonne National Laboratory.

11:06AM GG.00002 A New Measurement of the Proton Elastic Form Factor Ratio at Low $Q^2$, XIAOHUI ZHAN, MIT — A high precision measurement of the proton elastic form factor ratio $\mu_{G}/\mu_{M}$ in the range of $Q^2=0.3 - 0.7$ (GeV/c)$^2$ has been made using recoil polarimetry in Jefferson Lab Hall A. In this low $Q^2$ range, previous data (BLAST: C. B. Crawford et al. 2007, Phys. Rev. Lett. 98 052301, LEDEX, G. Ron et al. 2007, Phys. Rev. Lett. 99 202002) along with many fits and calculations indicate substantial deviations of the ratio from unity, and continue to suggest that structures might be present in the individual form factors, and in the ratio. In this new measurement, we used the high resolution spectrometer to detect recoil protons coincident with the elastic scattered electrons tagged by BigBite calorimeter. With 80% polarized electron beam for 24 days, we are able to achieve $\sim 0.5\%$ statistical uncertainty. This high precision result will confirm or refute all existing suggestions of few percent structures in the form factors ratio. Beyond the intrinsic interest in nucleon structure, the improved form factor measurements also have implications for DVCS, determinations of the proton Zemach radius and for parity violation experiments.

11:18AM GG.00003 Gluonic Pole Matrix Elements for Fragmentation Function and Universality1, LEONARD GAMBERG, Penn State University Berks — The non-vanishing of gluonic pole matrix elements can explain the appearance of transverse single spin asymmetries (TSSAs) in high-energy scattering processes. Such matrix elements appear in principle both for transverse momentum dependent (TMD) distribution functions such as the Sivers function and fragmentation functions such as the Collins function. We find that for a specific class of model field theories that the contribution of the gluonic pole matrix element for fragmentation functions vanishes. This outcome is important in the study of universality for fragmentation functions and has impact for QCD theory as it relates to experiments exploring the generalized angular momentum structure of the nucleon. With this result we explore various transverse spin and azimuthal asymmetries for hard process for various experimental facilities such as JLAB and RHIC-Spin.

1This work is supported in part by a grant U.S. Department of Energy under contract DE-FG02-07ER41460

11:30AM GG.00004 Double Spin Asymmetry for Exclusive $\pi^-$ Electro-production from Deuterium, SHARON CARECCIA, Old Dominion University, CLAS COLLABORATION — At Jefferson Lab, an extensive program of spin structure function experiments is underway in Hall B. We scatter longitudinally polarized electrons with energies of 1.6, 2.5, 4.2, and 5.7 GeV from longitudinally polarized NH$_3$ and ND$_3$ targets. The large acceptance of the CLAS spectrometer enables the detection of multi-particle final states over a large kinematical range in invariant mass $W$ and momentum transfer $Q^2$. In particular, we have studied exclusive $\pi^-$ production in the resonance region from the deuteron target, which is sensitive primarily to neutrons in the target. Preliminary results for the double polarization asymmetry for the 2.5 GeV data will be presented.

11:42AM GG.00005 Local Polarimetry for Proton Beams with the STAR Zero Degree Calorimeters, DAVID GROSNICK, Valparaiso University, STAR COLLABORATION — A spin physics program using the STAR detector at RHIC is underway that investigates the spin structure of the proton using colliding polarized proton beams at $\sqrt{s} = 200$ GeV, and in the future at 500 GeV. The local polarimeter that uses the beam- beam counters currently works well at $\sqrt{s} = 200$ GeV, but its effectiveness at higher energies may be problematic since the $\sqrt{s}$ dependence of the analyzing power is not known. Data at $\sqrt{s} = 200$ GeV using the Shower Maximum Detectors of the Zero Degree Calorimeters (ZDC) were analyzed to determine the feasibility of using the ZDCs as a second local polarimeter. A six sigma left-right physics asymmetry and an up-down physics asymmetry consistent with zero were measured from a small dedicated data sample with vertical beam polarizations. The physics asymmetry was also calculated as a function of azimuthal angle and displayed a sinusoidal pattern, as expected. These results demonstrate the capability of using the ZDCs as another local polarimeter for STAR at $\sqrt{s} = 200$ GeV, and the performance of both polarimeters will be measured at $\sqrt{s} = 500$ GeV.


1DE-FG02-01ER41200

12:06PM GG.00007 Hard Exclusive Processes on $^4$He1, SIMONETTA LIUTI, University of Virginia — We investigate both Deeply Virtual Compton Scattering (DVCS) and $\pi^0$ production off nuclear targets in the coherent and incoherent channels. The spin zero of the $^4$He target allows on one side a simpler description of its partonic structure characterized at leading twist by two Generalized Parton Distributions (GPDs), a chirally-even one, $H_A$ and a chirally-odd one, $H_B$. The two GPDs can be studied separately in the DVCS and $\pi^0$ production processes, respectively. Theoretical results using a microscopic approach to nuclear dynamics will be presented on the interpretation of GPDs in nuclei [1.2], as a means to unravel the transverse structure of nuclei in terms of both spatial and momentum degrees of freedom. Calculations of both asymmetries and cross sections for both the Bethe-Heitler and DVCS processes relevant for upcoming measurements at Jefferson Lab [3] will also be discussed. [1] S. Liuti and S.K. Taneja, Phys.Rev. C 72 034902,2005. [2] S. Liuti and S.K. Taneja, Phys. Rev. C 72 032201 (2005) [3] H. Egyean, F.-X. Girod, K. Hafidi, S. Liuti, E. Voutier et al., JLab Experiment E08-024 (2008)

1DE-FG02-01ER41200
Recent results on the properties of rotating neutron stars with a particular emphasis on rapid rotations. A connection between a description based on partonic degrees of freedom, given in terms of Generalized Parton Distributions (GPDs), and Regge phenomenology is discussed. Pion electroproduction is described in terms of the chiral odd (spin flip) GPDs for both longitudinal and transverse virtual photon polarizations. A mechanism for the $Q^2$-dependence of the $\gamma^*\pi^0$ vertex is proposed that, by treating separately natural and unnatural parity exchanges at this vertex, allows one to separate the transverse and longitudinal virtual photon contributions, the latter being dominated by unnatural exchanges. A study of the sensitivity of different observables in both unpolared and polarized scattering to both the tensor charge and the transverse anomalous magnetic moment is presented, with the aim of providing a practical method for extracting the latter. Further investigations using a variety of targets (proton, deuterium, and $^4$He), or involves – both electron and neutrino scattering as well as hadronic reactions will be discussed. [1] S. Ahmad, G. R. Goldstein and S. Liuti, arXiv:0805.3568 [hep-ph] [2] M. Burkardt, Phys. Lett. B 639, 462 (2006).

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**Saturday, October 25, 2008 10:30AM - 12:06PM –**

Session GH Astrophysics: Modelling  
Jewett Ballroom F

**10:30AM GH.00001 Molecular dynamics simulations of the crust of accreting neutron stars.** CHARLES HOROWITZ, Indiana University — We model the crust of accreting neutron stars with molecular dynamics simulations involving complex compositions with many different impurities as predicted by rapid proton capture nucleosynthesis and electron capture calculations. We present results for the phase structure, thermal conductivity, and screening factors for nuclear reactions. We find a lattice structure with a high thermal conductivity, instead of an amorphous solid, and we discuss the distribution of impurities. These thermal conductivity results agree with X-Ray observations of crust cooling for neutron stars after extended outbursts. We find that screening factors for the enhancement of thermonuclear reactions may be insensitive to the large scale distribution of impurities in the solid. Fusion of neutron rich oxygen isotopes such as $^{24}$O and $^{24}$O may be an important heat source at densities near ten to the eleventh g/cm$^3$. Indeed these and similar fusion reactions may be important to heat the crust to carbon ignition temperatures in superbursts. [1] C. J. Horowitz, D. K. Berry, and E. F. Brown, PRE75 (2007) 066101. [2] C. J. Horowitz, H. Dussan, and D. K. Berry, arXiv:0710.5714.

**10:42AM GH.00002 ABSTRACT WITHDRAWN —**

**10:54AM GH.00003 Viscosity and r-mode damping in stars with quark matter.** GAUTAM RUPAK, Mississippi State University, PRASHANTH JAIKUMAR, Institute of Mathematical Sciences, India and Argonne National laboratory, ANDREW W. STEINER, Michigan State University — The effect of shear and bulk viscosity on r-mode oscillations in compact stars with quark matter is presented. We consider both the ungapped and gapped color-flavor-locked (CFL) phase of quark matter. In ungauged quark phase r-mode is damped for temperatures $10^9$ K $-$ $5 \times 10^9$ K even for rapid rotations whereas in CFL phase r-mode is not damped in the temperature range $10^{10}$ K $-$ $10^{11}$ K. We find viscous damping of r-mode in quark matter leads to larger critical frequencies and smaller spin-periods compared to rotating neutron stars.

**11:06AM GH.00004 Non-inertial effects in reactions of astrophysical interest.** JUNTING HUANG, CARLOS BERTULANI, PLAMEN KRASTEV, Texas A&M University-Commerce — We report on novel effects due to non-inertial motion in reactions occurring in stars, and elsewhere. Applying Einstein's equivalence principle, we explore the corrections induced by strong gravitational fields on nuclear reactions in massive and/or compact stars. We find that non-inertial effects will appreciably modify the excitation processes in nuclear and atomic collisions.

**11:18AM GH.00005 Detection of supernovae neutrinos with neutrino-iron scattering.** ARTURO SAMANA, CARLOS BERTULANI, Texas A&M University - Commerce — The $\nu_e$-$^56$Fe cross section is evaluated in the projected quasiparticle random phase approximation (QPRPA). This model solves the puzzle observed in RPA for nuclei with mass around $^{12}$C, because it is the only RPA model that treats the Pauli principle correctly. The cross sections as a function of the incident neutrino energy are compared with recent theoretical calculations of similar models. The average cross section weighted with the flux spectrum yields a good agreement with the experimental data. The expected number of events in the detection of supernova neutrinos is calculated for the LVD detector leading to an upper limit for the electron neutrino energy of particular importance in this experiment.

**11:30AM GH.00006 Transport properties of nucleons.** SERGEY POSTNIKOV, MADAPPA PRAKASH, Ohio University — Results for the coefficients of diffusion, thermal conductivity, bulk and shear viscosities of a homogeneous system of nucleons will be presented. In the nondegenerate regime, the Chapman-Enskog theory provides an approximate solution to the Boltzmann equation and casts the transport properties in terms of appropriate transport integrals. In this case, the necessary differential cross sections are calculated using phase shifts extracted from scattering experiments. In the degenerate regime, many-body methods developed in the context of liquid helium-3 are employed. Techniques to cover the partially degenerate regime are also explored. The extent to which these transport coefficients are relevant in the dynamical evolutions of supernovae and neutron stars will be examined.

1 Research support from the Department of Energy under Grant No. DE-FG02-93ER41200

**11:42AM GH.00007 Nuclear constraints on properties of rotating neutron stars.** PLAMEN KRASTEV, TAMU-Commerce and San Diego State University, AARON WORLEY, BAO-AN LI, Texas A&M University-Commerce — Nuclear reactions with radioactive beams provide unique means to constrain the equation of state (EOS) of neutron-rich matter, in particular its density dependence through the nuclear symmetry energy. The EOS is important for our understanding of numerous phenomena in both nuclear physics and astrophysics. In this talk we will present our most recent results on the properties of rotating neutron stars with a particular emphasis on rapid rotations.
11:54AM GH.00008 Determining Entropy Generation in the Early Universe / Links to CMBR Spectra & neutrino and relic graviton production issues, ANDREW BECKWITH — We analyze how entropy is generated via a semiclassical argument as well as by multiple brane-anti brane combinations leading to an initial soliton-instanton formation. The supposition is that the two different types of methods give similar initial conditions for entropy and information/computational bits of information in the initial universe. We close then with observations we think are pertinent to entropy increase and also the variation of statistical noise about the CMBR spectra. This ties in with possible new species of detectable ‘neutrinos’ which lead to an extension of the standard model, since the derived ‘axion’ is coupled to photons to the tune of $f_a = 0(10^{11} \text{GeV})$ which is too large for Earthbound experiments (but which is in the range of space based experiments/data collection of astro physical phenomena, which could be detected by analysis of the CMBR spectra). This if there is a tie in with relic gravitons and the new neutrino candidate, indicates new detection schemes for both, which could be detected by both the new Li-Baker gravity wave detector, as well as Ice Cube.

Saturday, October 25, 2008 2:00PM - 3:48PM —
Session HA Topics in Nucleon Structure  Simmons Ballroom 2-3

2:36PM HA.00002 Overview of nucleon form factor measurements, MARK JONES, Jefferson Lab — The promise of high current and high polarization electron beams has been realized in the precision measurements of space-like proton and neutron magnetic and electric form factors. Experiments have utilized various combinations of polarized targets, recoil polarimetry and large acceptance detectors to measure the form factors. Experimentally, the strange content of the nucleon form factor has been probed by measuring beam asymmetries in parity violating electron scattering. New measurements of the proton form factor in the time-like region have been done. All this new data has had a tremendous impact on our understanding of nucleon structure. An overview of present status of nucleon form factor measurements will be presented.

2:36PM HA.00003 Transition Form Factors at JLab: A Unique Tool to Study the Evolution of the Strong Interaction, RALF GOTHE, University of South Carolina — Understanding the strong interaction in the non-perturbative regime constitutes one of the biggest challenges in fundamental science that we can and have to tackle now as the needed experimental and theoretical tools become available. Perturbative Quantum ChromoDynamics (pQCD) at small distances, which is governed by quark and gluon fields, and Chiral Perturbation Theory (ChPT) at larger distances, which is governed by pion fields, are both already experimentally validated. However, strong fields at intermediate distances, where they generate about 98% of the total mass of nucleons and therefore of all normal matter, are not understood on similarly firm grounds. Nucleon (N) to excited nucleon (N*) transition form factors at Jefferson Lab, and in particular with the 12 GeV upgrade, serve as an ideal tool to investigate the evolution of the strong interaction in this intermediate region. The experimental and theoretical status of the research program at Jefferson Lab to study baryon transition form factors and hence the evolution of the underlying effective degrees of freedom, or the origin of mass, will be exemplified by recent results. A thoroughly consistent extraction of resonance parameters within various different models from high precision data in various exclusive production channels will be present.

3:12PM HA.00003 Transition Form Factors at JLab: A Unique Tool to Study the Evolution of the Strong Interaction, RALF GOTHE, University of South Carolina — Understanding the strong interaction in the non-perturbative regime constitutes one of the biggest challenges in fundamental science that we can and have to tackle now as the needed experimental and theoretical tools become available. Perturbative Quantum ChromoDynamics (pQCD) at small distances, which is governed by quark and gluon fields, and Chiral Perturbation Theory (ChPT) at larger distances, which is governed by pion fields, are both already experimentally validated. However, strong fields at intermediate distances, where they generate about 98% of the total mass of nucleons and therefore of all normal matter, are not understood on similarly firm grounds. Nucleon (N) to excited nucleon (N*) transition form factors at Jefferson Lab, and in particular with the 12 GeV upgrade, serve as an ideal tool to investigate the evolution of the strong interaction in this intermediate region. The experimental and theoretical status of the research program at Jefferson Lab to study baryon transition form factors and hence the evolution of the underlying effective degrees of freedom, or the origin of mass, will be exemplified by recent results. A thoroughly consistent extraction of resonance parameters within various different models from high precision data in various exclusive production channels will be present.

2:00PM HB.00001 Neutron Cross Section Covariances: Recent Workshop and Advanced Reactor Systems, PAVEL OBOZINSKY\textsuperscript{1}, National Nuclear Data Center, Brookhaven National Laboratory — The recent Workshop on Neutron Cross Section Covariances, organized by BNL and attended by more than 50 scientists, responded to demands of many user groups, including advanced reactor systems, for uncertainty and correlation information. These demands can be explained by considerable progress in advanced neutronics simulation that probe covariances and their impact on design and operational margins of nuclear systems. The Workshop addressed evaluation methodology, recent evaluations as well as user’s perspective, marking era of revival of covariance development that started some two years ago. We illustrate urgent demand for covariances in the case of advanced reactor systems, including fast actinide burner under GNEP, new generation of power reactors, Gen-IV, and reactors under AFCI. A common feature as user’s perspective, marking era of revival of covariance development that started some two years ago. We illustrate urgent demand for covariances in the case of advanced reactor systems, including fast actinide burner under GNEP, new generation of power reactors, Gen-IV, and reactors under AFCI. A common feature

1In collaboration with: Mike Herman, National Nuclear Data Center, Brookhaven National Laboratory

2:36PM HB.00002 Nuclear reaction modeling for energy applications, TOSHIHIKO KAWANO, PATRICK TALOU, Los Alamos National Laboratory — We discuss how nuclear reaction theories are utilized in the nuclear energy applications. The neutron-induced compound nuclear reactions, which take place from in the sub-eV energy range up to tens of MeV, are the most important mechanism to analyze the experimental data, to predict unknown reaction cross-sections, to evaluate the nuclear data for databases such as ENDF (Evaluated Nuclear Data File), and (4) to reduce the uncertainties. To improve the predictive-power of nuclear reaction theories in future, further development of compound nuclear reaction theories for fission and radiative capture processes is crucial, since these reaction cross sections are especially important for nuclear technology. An acceptable accuracy of these cross-sections has been achieved only if they were experimentally confirmed. However, the compound reaction theory is getting more important nowadays as many rare nuclides, such as americium, are involved in applications. We outline future challenges of nuclear reaction modeling in the GNASH/McGNASH code, which may yield great improvements in prediction of nuclear reaction cross-sections.
2:48PM HB.00003 Measurement of the Spectrum of Neutrons Emitted in Neutron-Induced Fission, ROBERT HAIGHT, Los Alamos National Laboratory — The spectrum of neutrons emitted in fission is the source term for neutron transport in fission reactors and other systems. This spectrum is expected to change with incident neutron energy, and the energy dependence is described by the Los Alamos Model and implemented in the ENDF/B-VII evaluated nuclear data file. A collaboration among researchers from LANL, CEA (France), and Lawrence Livermore National Laboratory is measuring the fission neutron spectrum as a function of incident neutron energy using a double time-of-flight technique at the Los Alamos Neutron Science Center. Recent results for that part of the spectrum between 1 and 8 MeV for fission of 235U and 239Pu induced by neutrons from 1 to 50 MeV will be reported, and plans for future measurements will be outlined.

3:00PM HB.00004 Recent Advances in Resonance Region Nuclear Data Measurements and Analyses for Supporting Nuclear Energy Applications, MICHAEL DUNN, Oak Ridge National Laboratory — For over 30 years, the Oak Ridge National Laboratory (ORNL) has performed research and development to provide more accurate nuclear cross-section data in the resonance region. The ORNL Nuclear Data (ND) Program consists of four complementary areas of research: (1) cross-section measurements at the Oak Ridge Electron Linear Accelerator; (2) resonance analysis methods development with the SAMMY R-matrix analysis software; (3) cross-section evaluation development; and (4) cross-section processing methods development with the AMPX software system. The ND Program is tightly coupled with nuclear fuel cycle analyses and radiation transport methods development efforts at ORNL. Thus, nuclear data work is performed in concert with nuclear science and technology needs and requirements. Recent advances in each component of the ORNL ND Program have led to improvements in resonance region measurements, R-matrix analyses, cross-section evaluations, and processing capabilities that directly support radiation transport research and development. Of particular importance are the improvements in cross-section covariance data evaluation and processing capabilities. The benefit of these advances to nuclear science and technology research and development will be discussed during the symposium on Nuclear Physics Research Connections to Nuclear Energy.

3:12PM HB.00005 The Fission TPC Project, TONY HILL, LANL, JENN KLAY, California Polytechnic State University, MIKE HEFFNER, LLNL, NIFFTE COLLABORATION — High precision fission experiments have become a priority within the nuclear energy community due to a growing, world wide, interest in nuclear reactors. In particular, the design of the next generation reactors requires a reduction in the errors on a number of cross section measurements. Most of the required nuclear data has been measured over the last 50 years, although improvements in the accuracy of the data appear unlikely with the current technology. A potential breakthrough is the deployment of a detector developed within the particle physics community called the Fission TPC. A group of 6 universities and 3 national laboratories have undertaken the task of building the first FPC for this purpose. In this talk we will present the Fission TPC concept, and why we think we can make an improvement on 50 years of fission study.

3:24PM HB.00006 Distinguishing fissions of $^{239}$Pu and $^{235}$U with low-resolution detectors, E. SWANBERG, E.B. NORMAN, S.G. PRUSSIN, H. SHUGART, UC Berkeley, E. BROWNE, LLNL — When $^{239}$Pu and $^{235}$U undergo thermal neutron-induced fission, both produce significant numbers of $\beta$-delayed gamma rays with energies in the several MeV range. Experiments using high-energy-resolution germanium detectors have shown that it is possible to distinguish the fission of $^{239}$Pu from that of $^{235}$U. Using differences in the temporal behavior and in the shapes of the gamma-ray energy spectra, we show that these two isotopes can also be differentiated using low-resolution plastic or liquid scintillators. It is likely this method could be extended to homeland security applications, such as screening of cargo containers for $^{235}$U and $^{239}$Pu, using a neutron source and such scintillators.

Saturday, October 25, 2008 2:00PM - 3:36PM – Session HC Mini-Symposium: Neutrino Properties and Nuclear Physics V, Jewett Ballroom A-B

2:00PM HC.00001 What’s Needed, What’s Available, Where to Find it, What’s Not Available and How to Go About it?1, WERNER TORNOW, Department of Physics/TUNL Duke University — I briefly summarize some of the nuclear data needed for background correction of existing and future data in neutrino physics studies, double-beta decay and dark-matter searches. The focus is on neutron induced background which can mimic the signal of interest. Here, reactions induced by low-energy neutrons (<30 MeV or so) are of major concern, while higher energy neutrons produce charged-particle events which can be more easily distinguished from the events of interest. Although experimental data for the differential elastic scattering cross section do not exist for all nuclei of interest, they can fairly accurately be calculated using existing models. Inelastic scattering differential cross-section data and $(n,2n)$ reaction data are more of a problem because here both data and calculations are scarce or even completely missing for some of the nuclei of interest. Neutron induced reactions with charged-particles in the exit channel tend to be less of a problem for neutrino physics, double-beta decay and dark-matter studies due to their well defined signature. I will conclude by mentioning the existing facilities where some of the missing data can potentially be measured.

1Supported by U.S. DOE and NSF.
2:12PM HC.00002 Neutron-Induced Partial $\gamma$-ray Cross-Section Measurements on Cu, Ge and Pb1, E. Kwan, J.H. Esteline, B. Fallin, C.R. Howell, A. Hutcheson, M.F. Kidd, A. Tonchev, W. Tornow, Duke Univ. & TUNL, H.J. Karwowski, UNC-Chapel Hill & TUNL, J.H. Kelley, Y. NCSU & TUNL, D.M. Mei, Univ. of S. Dakota — In high-precision low-statistic measurements such as those carried out in deep underground low-background environments, naturally-occurring radiation can obscure the region of interest. For example, energetic neutrons produced from natural radioactivity or muon-induced reactions will interact with the experimental apparatus producing a continuous background. A survey of neutron-induced $\gamma$-ray transitions in $^{64}$Cu, enriched $^{76}$Ge, and $^{64}$Pb from 150-4000 keV was carried out at TUNL using pulsed mono-energetic neutron beams, with an emphasis on the region around 2039 keV where $0\nu\beta\beta$ decay peak of $^{76}$Ge is expected to appear. Transitions at 2041, 2615, and 3062 keV in the shielding materials of Pb and Cu may either directly interfere with the $^{76}$Ge $0\nu\beta\beta$ peak at 2039 keV or may produce nearby escape peaks. The rates at which these background peaks occur are needed to determine whether events due to $0\nu\beta\beta$ decay are observed and whether neutrinos are indeed their own anti-particles.

1 This work was supported in part by DOE grant DE-FG02-97ER41033, DE-FG02-97ER41042, and DE-FG02-97ER41041.

2:24PM HC.00003 Radionuclide Production Cross Sections from 800-MeV Proton Interactions in Ge and Mo Targets1, B. Quiter, E.B. Norman, UC Berkeley, A.R. Smith, LBNL, S.A. Wender, R.C. Haight, LANL, A.F. Barghouty, NASA — Minimization of radioactive backgrounds is critical for experiments attempting to measure neutrinoless double beta decay ($0\nu\beta\beta$). To estimate cosmic ray-induced radionuclide production in $0\nu\beta\beta$ experiments, we have irradiated targets composed of natural isotopic composition molybdenum and germanium with 800 MeV protons at the Los Alamos Neutron Science Center (LANSCE). The targets were counted with high-purity germanium detectors at Lawrence Berkeley National Laboratory intermittently from 2 weeks to 1 year after irradiation to determine the cumulative cross sections for radionuclide production. In total, 30 radioactive products were observed in the Mo target and 20 in the Ge target. Our experimental results are compared with the predictions from the semi-empirical Silberberg and Tsao code as well as previously reported Mo experimental data.

1 Supported in part by the US Dept. of Energy.

2:36PM HC.00004 Cosmic ray contribution to the Cuoricino background, Laura Kogler, LBNL, CUORE COLLABORATION — CUORE is a proposed next-generation bolometric experiment to search for neutrinoless double beta decay in 130tOe. Cuoricino is the recently finished prototype experiment for CUORE. To reach its goal, CUORE must achieve a background level of less than 0.01 counts/kev/kg/year. One potential source of background comes from cosmic ray muons. The experiment is located at a depth of 3500 m.w.e. in the Gran Sasso National Laboratories in Italy, where there is an average muon flow of approximately 1 per square meter per hour. We have investigated the contribution of cosmic ray muons to the background of Cuoricino by installing plastic scintillator muon counters outside of the detector to directly measure the correlation between intercepted muons and recorded events in the detector. We will present the results of this analysis and the implications for Cuoricino and CUORE.

2:48PM HC.00005 A Model of Nuclear Recoil Scintillation Efficiency in Noble Liquids, Dongming Mei, The University of South Dakota, Zhongbao Yin, Laura Stonehill, Andrew Hime, Los Alamos National Laboratory — Scintillation efficiency of low-energy nuclear recoils in noble liquids plays a crucial role in interpreting results from some direct searches for Weakly Interacting Massive Particles (WIMP) dark matter. Understanding the scintillation efficiency relative to electronic recoils in noble liquids remains unclear at the moment. We attribute such a reduction of scintillation efficiency to two major mechanisms: 1) energy loss and 2) scintillation quenching. The former is commonly described by Lindhard’s theory and the latter by Birk’s saturation law. We propose to combine these two to explain the observed reduction of scintillation yield for nuclear recoils in noble liquids. Birk’s constants $k_B$ for argon, neon and xenon determined from existing data are used to predict noble liquid scintillator’s response to low-energy nuclear recoils and low-energy electrons. We find that energy loss due to nuclear stopping power that contributes little to ionization and excitation is the dominant reduction mechanism. We have calculated the scintillation efficiency for nuclear recoils, but that significant additional quenching results from the nonlinear response of scintillation to the ionization density.

3:00PM HC.00006 Nuclear Quenching in Gaseous Argon, Kareem Kazzaz, Adam Bernstein, LNL, Michael Foxe, Purdue University / LNL, Christian Hagemann, LNL, Igor Jovanovic, Purdue University, Wolfgang Stoefffl, LNL, Celeste Winant, UCSF — In many media and with varying degrees of efficiency, nuclear recoils can induce ionization and/or scintillation. These nuclear recoil signatures can be used in dark matter searches and neutrino physics experiments, and to detect neutrons. To understand the behavior of the ionization process induced by nuclear recoils, nuclear quenching factors must be measured at various ionization energies to properly reconstruct the recoil event. In this context, the quench factor is defined as the ratio of the number of electron-ion pairs produced by a nuclear recoil of a given energy to the number produced by an electron recoil of the same energy. Taking advantage of a unique 60 keV portable neutron source developed by LNL, we will present latest results from our efforts to measure the nuclear quenching factor in gaseous argon at the lowest energy yet attempted. We also discuss using nuclear recoils in liquid argon to search for coherent neutrino scatters.

1 This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory in part under Contract W-7405-Eng-48 and in part under Contract DE-AC52-07NA27344.

3:12PM HC.00007 Measurements of $F_2$ and $R = \sigma_L/\sigma_T$ on Deuteron and Nuclei in Nucleon Resonance Region, Y. Li, Hampton University, JLAB E02-109 COLLABORATION, JLAB E04-001 COLLABORATION — Jefferson Lab Experiment E02-109/E04-001 study the longitudinal-transverse (L-T) separated structure functions $F_1, F_2, F_L$ and the ratio of longitudinal and transverse cross sections $R = \sigma_L/\sigma_T$ from deuteron and other nuclear targets (Carbon, Iron and Aluminum) in nucleon resonance region. The experiments will provide the first global survey of the L-T separated quantity of the nuclei in resonance region. In addition, these data will be used as input vector form factors in a future analysis of neutrino data. After a brief presentation of the motivation of the experiments and associated analysis details, the preliminary results will be presented.

3:24PM HC.00008 A Measurement of $F_2$ and $R = \sigma_L/\sigma_T$ on Nuclear targets in the Nucleon Resonance Region, Vahe Mamyyan, University of Virginia — Jefferson Lab Experiment E04-001 used the Rosenbluth technique to measure $R = \sigma_L/\sigma_T$ and $F_0$ on deuterium and nuclear targets. This experiment was part of a multilab effort[1] to investigate quark-hadron duality and the electromagnetic and weak structure of the nuclei in the resonance region. In addition to the studies of quark-hadron duality in electron scattering on nuclear targets, these data will be used as input form factors in future analysis of neutrino data which investigate quark-hadron duality of the nucleon and nuclear axial structure functions. An important goal of this experiment is to provide precise data which to allow a reduction in uncertainties in neutrino oscillation parameters for neutrino oscillation experiments (K2K, MINOS). This inclusive experiment was completed in July 2007 at Jefferson Lab where the Hall C High Momentum Spectrometer detected the scattered electron. Measurements were done in the nuclear resonance region ($1 < Q^2 < 4.0/(GeV^2))$ spanning the four-momentum transfer range $0.5 < q^2 < 4.0/(GeV^2)$. Data was collected from four nuclear targets: C, Al, Fe and Cu. After a brief presentation of the motivation of the experiment and its experimental and analysis details, the preliminary results will be presented. [1] Fermilab Minerva Experiment[http://minerva.fnal.gov/]

1 A. Bodek and C. Keppel, spokespersons
of particles of a particular angular momentum. States must be orthogonal. Despite this one gets reasonable results for $^{46}$Ti and $^{48}$Ti. Isospin considerations can simplify expressions for the number of pairs states for a system of 2 protons and 2 neutrons. If in the even-even Ti isotopes we constrain the angular momenta of the 2 protons and 2 neutrons to be either $a+b/4$. How can a constant tell us something useful? Using the above isospin interaction we can get a relation involving the number of isospin $T=0$ and $T=2$ number of states of 3 identical particles in a $j$ shell with $J=j$. This is at first surprising because for identical particles the above isospin interaction is a constant $+d(-1)^{\gamma}$. For Strategic Research.

This research supported by the U. S. Department of Energy under contract W-7405-ENG-36.

2:12PM HD.00002 The Nuclear Born Oppenheimer Method and Nuclear Rotations, NOUREDINE ZETTIILI, Jacksonville State University — In this presentation, we want to discuss how to apply the Nuclear Born Oppenheimer (NBO) formalism to the description of nuclear rotations. This application will be illustrated on nuclei that are axially-symmetric and even (but non-closed shell). We will focus, in particular, on the derivation of expressions for the energy and for the moment of inertia. In addition, we will examine the connection of the NBO method with the self-consistent cranking model. We will compare the moment of inertia generated by the NBO method with the Thouless-Valatin formula and hence establish a connection between the NBO method and the large body of experimental data.

Supported in part by the Alabama Commission on Higher Education.

2:24PM HD.00003 Nuclear structure with the algebraic collective model, M.A. CAPRIO, University of Notre Dame, D.J. ROWE, T.A. WELSH, University of Toronto — A tractable scheme for numerical diagonalization of the Bohr Hamiltonian, based on $SU(1,1)$ and $SO(5)$ algebraic methods, has recently been proposed. The direct product basis obtained from an optimally chosen set of $SU(1,1)$ basis wave functions and the $SO(5)$ spherical harmonics $\Psi_{\nu\alpha LM}(\gamma, 0)$ provides an exceedingly efficient basis for numerical solution, as compared to conventional diagonalization in a five-dimensional oscillator basis. In this talk, the status of the $SU(1,1) \times SO(5)$ algebraic collective model will be summarized and applications will be presented. In particular, the transition from axially symmetric to triaxial structures will be explored. Supported by the US DOE under grant DE-FG02-95ER-40934.

Supported in part by USDoe grants DE-FC02-07ER41457 and DE-FG-02-87ER40371.

2:36PM HD.00004 Light nuclei without a core, PIETER MARIS, Dept. of Physics and Astronomy, Iowa State University, Ames, IA 50011, ANDREY SHIROKOV, Skobeltsyn Institute of Nuclear Physics, Moscow State University, Moscow, 119991 Russia, JAMES VARY, Dept. of Physics and Astronomy, Iowa State University, Ames, IA 50011 — We report on recent progress in ab initio no-core full configuration basis calculations. We present results for the ground state energy and spectrum for the low-lying states of nuclei up to $A = 14$ using a realistic NN interaction, JISP16. Our spectra are in reasonable agreement with available experimental data. In addition to the energies, we also calculate selected observables such as rms radii and quadrupole moments.

Supported in part by US DOE grants DE-FC02-07ER41457 and DE-FG-02-87ER40371.

2:48PM HD.00005 Pairing in Small, 2D Fermi Systems, JEREMY ARMSTRONG, Lund University, MASSIMOMONTANTI, CNR-IFIN National Research Center, SVEN ABERG, Lund University, VLADIMIR ŽELEVINSKY, Michigan State University, STEPHANIE REIMANN, Lund University — In recent years, trapped, ultra-cold atomic gasses have provided a rich testing ground for quantum theories. We apply a pairing model from nuclear physics to a 2D harmonically confined, two-component atomic gas containing 2-9 particles. Our Hamiltonian consists of the oscillator mean field and a contact pairing interaction. We calculate excitation spectra, yrast spectra, the BCS pairing gap, and addition energies for various values of the pairing strength. As expected, when the interaction is weak, the oscillator mean field is dominant, and as the interaction strength is increased, pairing effects become quite clear. Results are compared with ab initio calculations.

This work was supported by FIRB No RBIN04EY74 & RBIN06JB4C, PRIN No 2006022932, the Swedish Research Council and the Swedish Foundation for Strategic Research.

3:00PM HD.00006 An Isospin Revival for 2008, ARAM MEKJIAN, Rutgers University, LARRY ZAMICK, Rutgers University — We can make an association of isospin and angular momentum in a single $j$ shell. For 2 particles the interaction in isospin $a+b$ $t(1,2)(2)$ is equivalent to $c+d(-1)^{\gamma}$ where $J$ is the angular momentum of the 2 particles. Considering a system of one proton and 2 neutrons we are able to get a formula that counts the number of states of 3 identical particles in a $j$ shell with $J-j$. This is at first surprising because for identical particles the above isospin interaction is a constant $a+b/4$. How can a constant tell us something useful? Using the above isospin interaction we can get a relation involving the number of isospin $T=0$ and $T=2$ states for a system of 2 protons and 2 neutrons. In the even-even Ti isotopes we constrain the angular momenta of the 2 protons and 2 neutrons to be either zero or two. Then we find there is no freedom in which each of these angular momenta is present. This is because of the constraint that the $T=0$ and $T=2$ states must be orthogonal. Despite this one gets reasonable results for $46$Ti and $48$Ti. Isospin considerations can simplify expressions for the number of pairs of particles of a particular angular momentum.

For states of the \( (f7/2) \)\(^{157}\) transitions were identified in \( \leq \) atomic mass, the equation \( Y=K/X \) manifests an equal-side hyperbola which lies in the 1st quadrant (\( K \) up of the Table (a last element). To fill this gap a new theoretical approach is proposed, an essence of which is the idea that on any chemical composition the products came from nuclear reactions, where new elements may be discovered as well. This fact however gives no information about a possible limit in the periodic table.

However no one claim was made yet on the upper limit of the Table. The standard methods of nucleosynthesis of super-heavy elements include recognition of parentage \( \] 1\( \) predicts a sudden rise in \( E_0 \) transition strengths between the lowest two \( 0^+ \) states using the IBM-1, R.J. CASPERSON, E. WILLIAMS, V. WERNER, Yale University — The Interacting Boson Model-1 (IBM-1) predicts a sudden rise in \( E_0 \) transition strengths between the lowest two \( 0^+ \) states when crossing the phase transition from spherical to deformed nuclei. In addition, the \( E_0 \) strength is predicted to remain large toward the deformed limits, which was recently supported by new data. In order to identify characteristics of phase transitions and minimize finite \( N \) effects, large configuration spaces must be used. Arbitrary precision arithmetic has allowed for calculations of up to 400 bosons using the full parameter space of the IBM-1. The calculations to be presented show that the peaking of the \( E_0 \) strength at the first order phase transition and the large value in the deformed limit are two independent features. First calculations of isomer shifts for large boson numbers will also presented. Work supported by US DOE under grant number DE-FG02-91ER-40609.
2:24PM HE.00003 Probing asymptotic behavior of quantum shape phase transitional systems with angular momentum. E. WILLIAMS, R.J. CASPERSON, V. WERNER, Yale University — Scaling properties of quantum phase transitional (QPT) systems in atomic nuclei have been a subject of great interest in recent years, as the manner in which a system scales with system size is intimately connected to fundamental system dynamics, and provides a means of relating properties of finite, experimentally accessible QPT systems to their infinite size counterparts. In the present work, the scaling behavior of finite nuclear systems in the large boson limit is explored within the context of the Interacting Boson Model-1 for both first and second order QPT systems. The expected power law relationship between energies, transition strengths, and shape invariants with increasing boson number at the critical point in the continuous limit will be tested, and the effects of angular momentum on scaling properties of these observables will be investigated. The shape of the nuclear potential is found to strongly influence scaling behavior at the first order transition.

1Work supported by US DOE grant number DE-FG02-91ER-40609.

2:36PM HE.00004 Wobbling Beyond Lu: TSD Bands in $^{167}$Tal. D.J. HARLETT, E.P. SEYFRIED, J.R. VANHOY, US Naval Academy, I.G. DARBY, L.L. RIDINGER, Univ. of Tennessee, A. AGUILAR, M.A. RILEY, X. WANG, Florida State Univ., M.P. CARPENTER, C.J. CHIARA, R.V.F. JANSENS, F.G. KONDEV, T. LAURITSEN, E.A. MCCUTCHEAN, I. STEFANESCU, S. ZHU, Argonne National Lab, P. CHOWDHURY, S. LAKSHMI, S.K. TANDEL, U.S. TANDEL, Univ. of Massachusetts-Lowell, Q. IJAZ, W.C. MA, Mississippi State Univ., U. GARG, S. MUKHOPADHYAY, Univ. of Notre Dame — Perhaps the best indication of the rarely observed triaxial shape is the identification of the wobbling mode. This collective excitation occurs when an asymmetric nucleus is rotated at high spin. Currently, only $^{163,165,167}$Lu and perhaps $^{164}$Lu have displayed this exotic phenomenon. The fact that neighboring nuclei have not exhibited wobbling has led to the suggestion that the Lu proton Fermi surface is possibly the optimal location to observe wobbling and that no other isotope is likely to display this mode [1]. In order to test this theory, an experiment which populated high-spin states in $^{167}$Ta was performed. The $^{120}$Sn($^{14}$V,$\gamma$) reaction was used and Gammasphere detected the emitted $\gamma$ rays. A sequence based on the $i_{13/2}$ proton was identified for the first time, and a structure feeding into the $i_{13/2}$ band was also found. This latter structure is a strong candidate for the first wobbling band beyond Lu nuclei. Its characteristics will be compared with previously established wobbling sequences. [1] N.S. Pattabiraman et al., Phys. Lett. B 647, 243 (2007).

2:48PM HE.00005 Neutron damage tests of a highly segmented Germanium detector. T.J. ROSS, C.W. BEAUSANG, University of Richmond, I.Y. LEE, A.O. MACCHIAVELLI, S. GROS, M. CROMAZ, R.M. CLARK, P. FALLON, HENRIK JEPPESEN, Lawrence Berkeley National Lab., J.M. ALLMOND, University of Richmond — Gamma ray energy tracking arrays such as GRETINA/GRETA and AGATA are the latest evolution in gamma ray detection. By locating the interaction points, in 3-dimensions, of individual gamma ray interactions such arrays allow the energies of gamma rays to be reconstructed. This leads to excellent energy resolution, superior peak-to-total ratio and photo peak efficiency and resolving powers up to a thousand times superior to the best current generation array. The position information is extracted from the detailed pulse shapes recorded in each segment. It is anticipated that these tracking-detectors will experience significant neutron fluxes during in beam experiments. Thus it is important to test the response of highly-segmented Ge detectors when subjected to high-energy neutrons. In a one week test carried out at the 88-Inch Cyclotron at LBNL the P3 prototype detector for the GRETINA array was exposed to a neutron flux equivalent to at least one and a half years normal use. The detector was then successfully annealed. Preliminary results for the energy and position resolution, prior to and after neutron damage, and after annealing will be presented.

3:00PM HE.00006 Determination of the position resolution of a segmented HPGe detector using a collimated source. M. CROMAZ, I.Y. LEE, A.O. MACCHIAVELLI, M. WIEDEKING, R.M. CLARK, M.A. DELEPANQUE, P. FALLON, S. GROS, F. STEPHENS, H.B. JEPPESEN, Lawrence Berkeley National Laboratory, D. RADFORD, K. LAGERGREN, Oak Ridge National Laboratory — New techniques in the use of highly-segmented HPGe detectors enable the tracking of the path of a scattered gamma ray in the detector. This enables precision Doppler correction of gamma rays emitted from fast-moving sources for high-resolution spectroscopy at radioactive beam facilities. Critical to these applications is a knowledge of the position resolution to which the scattering points can be determined. We directly measured the position resolution of using a highly collimated Cs source. Signal decomposition was used to determine the position and charge deposition of the interaction points from the scattered gamma ray in the crystal, followed by tracking to identify the first interaction point. The set of first interaction points form a line through the detector and their dispersion gives the position resolution of the crystal in two dimensions. Such a measurement was performed with the 36-way segmented GRETINA P3 prototype detector the position resolution was found to be $\sigma_p = 1.5$ mm and $\sigma_\gamma = 1.7$ mm.

3:12PM HE.00007 Recent advances in the study of hyperdeformation at high spin. HAZEM ABUSARA, A.V. AFANASJEV, Mississippi State University — The systematic investigation of hyperdeformation (HD) at high spin in the Z=40-58 part of nuclear chart has been performed in the framework of the cranked relativistic mean field model. The properties of the HD bands such as quadrupole transition moments $Q_t$, dynamic $J^{(2)}$ and kinematic $J^{(1)}$ moments of inertia have been studied. These observables are affected by centrifugal stretching. Our self-consistent calculations suggest that necking degree of freedom should play an important role in some nuclei at hyperdeformation. It is especially pronounced in the proton density distribution due to the repulsive Coulomb force. The density of the HD bands is high in the spin range where they are yrast or close to yrast in the majority of cases. In these cases the observation of discrete HD bands is most likely to be impossible because the feeding intensity will be redistributed among many bands, thus, dropping below the observational limit of the experimental facilities. The calculations indicate Cd isotopes as the best candidates for a search of discrete HD bands. The HD configurations become yrast at lower spins in neutron-deficient nuclei than in the ones of the valley of $\beta$-stability. [1] W.Koepf and P.Ring, Nucl. Phys. A511, 279(1990), [2] A.V.Afanasjev and H.Abusara (submitted to Physical Review C)

3:24PM HE.00008 Study of $0^+$ States and Collectivity in $^{154}$Gd by the (p,$\gamma$) Reaction. J.M. ALLMOND, University of Richmond, VA, STARS LIBERACE COLLABORATION — Recent experiments [1] have revealed an unusual number of low-lying $0^+$ states (< 3 MeV) in a number of rare-earth nuclei, including $^{154,156}$Gd. Indeed, the structure of these and neighboring (N ~ 90) nuclei have been of recent interest [2]. To investigate the decay and population of these $0^+$ states, an experiment was conducted at the 88" cyclotron at LBNL using the STARS and LiBerACE detector arrays. A 25 MeV proton beam incident onto a $^{156}$Gd target was used to populate states in $^{154}$Gd by the (p,$\gamma$) reaction and $^{156}$Gd by (p,$\gamma$). The exit channel of the reaction and the residual excitation energy of the nucleus were tagged by detecting scattered charged particles in a Si telescope array (STARS) while coincident $\gamma$ rays were detected using 6 Ge clovers and 1 Ge LEPS detector of the LiBerACE array. Branching ratios, population distributions, and particle-$\gamma$ correlations are used to probe the nature of $0^+$ states and collectivity in $^{154}$Gd. Preliminary results are presented. DE-FG52-06NA26206 (UR), DE-AC52-07NA27344 (LLNL), and DE-AC02-05CH11231 (LBNL).

2:00PM HF.00001 HBT correlations of charged pion pairs in $\sqrt{s} = 200$ GeV $p+p$ collisions at RHIC-PHENIX. ANDREW GLENN, Lawrence Livermore National Lab, PHENIX COLLABORATION — Femtoscopy methods, such as those exploiting the Hanbury-Brown Twiss effect, have long been used to provide space-time information about the bulk medium formed in heavy ion collisions, but these techniques are capable of having a broader impact in understanding this data. Arguably, the most important effects observed at RHIC are the strong modifications of jets by the produced Quark Gluon Plasma and conversely, the feedback of the jet into the medium. The first experimental step for using HBT techniques to study these is the benchmark measurement for $p+p$ collisions, where kinematic correlations require careful consideration. Comparisons of correlations from minimum bias data to those from the region of a triggered jet are of particular importance. The status of the first HBT analysis for pions from $\sqrt{s} = 200$ GeV $p+p$ collisions measured by the PHENIX collaboration will be presented.

3:00PM HF.00006 Low mass lepton pair production at large transverse momentum. JIANWEI QIU, ZHONGBO KANG, Iowa State University, WERNER VOGELSANG, Brookhaven National Laboratory — PHENIX collaboration has recently measured the transverse momentum distribution of low mass lepton pair production in hadron-hadron, hadron-nucleus, and nucleus-nucleus collisions. We demonstrate that the transverse momentum distribution of low mass lepton pairs is extremely sensitive to the shape of gluon distribution.

2:12PM HF.00002 Pseudorapidity and $p_T$ dependence of identified-particle azimuthal flow for $\sqrt{s_{NN}} = 200$ GeV $Au+Au$ and $Cu+Cu$ collisions. VICTORIA ZHUOKOVA, U. Kansas, BRAHMS COLLABORATION — The observation of a strong azimuthal flow signature at RHIC suggests rapid system equilibration leading to an almost perfect fluid state. The longitudinal extent of the flow behavior depends on the formation dynamics for this state and can be studied by measuring the pseudorapidity dependence of the second Fourier component ($v_2$) of the azimuthal angular distribution. We report on a measured $v_2$ as a function of $p_T$ (0.5-2.0 GeV/c), centrality (50-50%), and pseudorapidity ($0 < \eta < 3.2$) for $\sqrt{s_{NN}} = 200$ GeV $Au+Au$ and $Cu+Cu$ collisions. The results are obtained using the BRAHMS spectrometers for particle identification ($\pi$, K, p) and the BRAHMS global detectors to determine the corresponding reaction-plane angles. Preliminary results for the Au+Au system have been reported earlier. Here we compare the final Au+Au results to new results obtained for the Cu+Cu system.

2:24PM HF.00003 Yields and elliptic flow of $d(\bar{d})$ and $^3He(^3He)$ in $Au+Au$ collisions at $\sqrt{s_{NN}} = 200$ GeV. JIANGHAN ZHOU, Rice University, JACK ENGELAGE, U.C. Berkeley, HAI DONG LIU, ZHANGBU XU, Brookhaven National Lab, BNL RHIC STAR COLLABORATION — We present the transverse momentum ($p_T$) spectra and the coalescence parameters $B_2$ (related to collisional volume) for $d$, $\bar{d}$ ($1 < p_T < 4$ GeV/c) and $^3He$, $^3He$ ($2 < p_T < 6$ GeV/c) at mid-rapidity in $Au+Au$ collisions at $\sqrt{s_{NN}} = 200$ GeV measured in the STAR experiment at RHIC. Spectra are in general agreement with the expected coalescence from nucleons with radial flow, but show softer $p_T$ distribution than predictions from a Blast-Wave model. The coalescence parameters are compared to track with pion HBT results in different collision geometry. The elliptic flow ($v_2$) measurement for $d(\bar{d})$ as a function of $p_T$ is found to follow an approximate atomic mass number $(A)$ scaling ($v_2(A)/v_2(3.1/2)$) while that of $^3He/\bar{d}^3He$ deviates more from the scaling ($v_2^3He/\bar{d}^3He = 4.3/2$). A negative $v_2$ has been observed for $d$ at low $p_T$, consistent with large radial flow in Au+Au collisions. We note that the ratio of the primordial deuteron abundances measured in Big Bang Nucleosynthesis (BBN) to that measured in a collider experiment at zero chemical potential is $\Omega_{BBN/RHIC} = (D/H)_{BBN}/(d/\bar{d})_{RHIC} = 0.036 \pm 0.004$. The very preliminary results from Cu+Cu collisions at $\sqrt{s_{NN}} = 200$ GeV will also be compared to the Au+Au system, hence providing a study to system size dependence.

2:36PM HF.00004 Baryon resonance yields after QGP hadronization. INGA KUZNETSOVA, JOHANN RAFELSKI, University of Arizona — Yields of baryon resonances which have been studied at RHIC, considering their decay (e.g. $\Delta(1232) \rightarrow N + \pi$, $\Sigma(1385) \rightarrow \Lambda + \pi$), are studied in the framework of a kinetic master equations. The detailed balance requirement implied that they can be also produced by back-reaction. Particularly interesting is the case of entropy rich QGP fast hadronization of entropy rich QGP. The total yields of the ground state baryons used in analysis of data (such as $N$, $\Lambda$) are not affected.

3:00PM HF.00005 Dielectron Continuum in $p+p$ Collisions at $\sqrt{s} = 200$ GeV measured by the PHENIX Experiment at RHIC. JASON KAMIN, Stony Brook University, PHENIX COLLABORATION — Color neutral probes, such as $e^+e^-$ pairs, do not interact with the hot, dense medium created in RHIC collisions. Therefore, they are effective tools for investigating the full time evolution and dynamics of this new state of matter. The intermediate mass region of the dielectron continuum ($1 < m < 3$ GeV/c$^2$) is dominated by semi-leptonic charm decays and allows a measurement of medium modifications of charm correlations. The PHENIX experiment has measured the dielectron continuum in both $p+p$ and heavy-ion collisions at $\sqrt{s} = 200$ GeV. The $p+p$ data from the 2006 RHIC run allowed a measurement of the charm cross section as well as providing a tantalizing glimpse of the bottom cross section. The increased luminosity of the 2006 RHIC run along with a higher electron trigger threshold provides increased statistics for the measurement of the dielectron continuum, particularly in the higher mass region (m>1 GeV/c$^2$). This enables an analysis of additional dependencies, such as the $p_T$ and azimuthal correlations, of $e^+e^-$ pairs originating from heavy flavor decays. Such a study can illuminate the production mechanism for heavy flavor and can provide a crucial benchmark to test pQCD while also providing a baseline for future heavy-ion runs. The status of the $p+p$ analysis from the 2006 RHIC run will be discussed.
3:12PM HF.00007 Centrality Dependent Studies of Identified Particle Spectra at RHIC1. 
SELEMON BEKELE, University of Kansas, BRAHMS COLLABORATION — We present preliminary results from the BRAHMS experiment on identified particle spectra and ratios at $y \sim 0$ and $y \sim 3$ as a function of centrality for 200 GeV/NN Cu+Cu collisions. By comparing the Cu+Cu data with earlier results for the Au+Au and d+Au systems, it is possible to study how the heavy-ion reaction dynamics for a given number of participants depends on the overall system size. Particle yields, $<p_T>$, and particle ratios are studied as a function of the number of participants. Transverse momentum distributions provide information on the final stages of the collision evolution at kinetic freeze-out. The kinetic freeze-out parameters of the Cu+Cu system are studied as a function of centrality by a simultaneous blast-wave model fit to the pion, kaon and (anti)proton spectra. The Cu+Cu results will be compared to other collision systems at RHIC to unravel the dependence on system size.

1This work was supported by the Office of Nuclear Physics of the U.S. Department of Energy.

3:24PM HF.00008 Coulomb Corrections and Ion Finite Size Effects in $\mu$ Pair Production at RHIC and LHC, ANTHONY BALTZ, Brookhaven National Laboratory — A higher order QED calculation of the ultraperipheral heavy ion cross section for $\mu^+\mu^-$ pair production at RHIC and LHC is carried out. The so-called “Coulomb corrections” lead to an even greater percentage decrease of $\mu^+\mu^-$ production from perturbation theory than the corresponding decrease for $e^+e^-$ pair production. Unlike the $e^+e^-$ case, the finite charge distribution of the ions (form factor) and the necessary subtraction of impact parameters with matter overlap are significant effects in calculating an observable ultraperipheral $\mu^+\mu^-$ total cross section.

3:36PM HF.00009 Parity Violation in Strong Interactions, DHEVAN GANGADHARAN, UCLA, STAR COLLABORATION — Recent theoretical findings suggest parity violation of the strong interaction. This may be seen in heavy-ion collisions through the separation of charged particles relative to the reaction plane of the colliding nuclei. Charged particle separation in heavy-ion collisions is by definition P-odd and is theoretically a consequence of a “topological charge” changing transition of the vacuum structure via instantons/sphalerons in the colliding region. Recent experimental results from the STAR detector at RHIC using charged particle correlations will be presented.

3:48PM HF.00010 Jet energy loss in a dynamical QCD medium, MAGDALENA DJORDJEVIC, Arkansas State University — We calculate, to first order in the number of scattering centers, the energy loss of a heavy quark traveling through a finite size QCD medium consisting of dynamical constituents. Our results suggest a simple general mapping between energy loss expressions for static and dynamical QCD media. Numerically, we show that the result for a dynamical medium is significantly larger compared to a medium consisting of randomly distributed static scattering centers. Therefore, an accurate description of jet suppression in RHIC and LHC experiments must correctly account for the dynamics of the medium’s constituents. Finally, we show that finite size effects induce a non-linear path length dependence of the energy loss, which effectively reproduces the effects of destructive Landau-Pomeranchuk-Migdal interference in the ultra-relativistic limit.

1This work was supported by the U.S. Department of Energy, grant DE-FG02-01ER41190.

Saturday, October 25, 2008 2:00PM - 3:36PM –
Session HG Electromagnetic Interactions II  Jewett Ballroom C

2:00PM HG.00001 Measurement of two-photon exchange effect with CLAS, MARYAM MOTEABBED, BRIAN RAUFE, Florida International University, CLAS COLLABORATION — The two-photon exchange phenomenon is believed to be responsible for the discrepancy observed between the ratio of proton electric and magnetic form factors, measured by the Rosenbluth and polarization transfer methods. This disagreement is about a factor of three at $Q^2$ of 5.6 GeV$^2$. The two-photon exchange (TPE) radiative correction can be directly measured by taking the ratio of the electron-proton and positron-proton elastic scattering cross sections, as it changes sign with respect to the charge of the incident particle. A test run of a modified beamline has been conducted with the CLAS detector at Thomas Jefferson National Accelerator Facility. This test run demonstrated the feasibility of producing a mixed electron/positron beam of good quality. In addition, $e^+p$ and $e^-p$ elastic scattering data were obtained for $Q^2$ up to nearly 1.0 GeV$^2$ and preliminary results will be presented.

2:12PM HG.00002 Diffractive Slope Extraction of Exclusive $\rho_1^0$ and $\rho_0^0$ at HERMES, BRIAN BALL, U of Michigan, HERMES COLLABORATION — Hard exclusive $\rho^0$ electroproduction from a $^2\text{H}$ target has been studied at the HERMES experiment. In particular, the meson helicity dependence of the cross-section slope parameter $b$ as a function of the squared four-momentum of the virtual photon $Q^2$ is presented. The parameter $b$ is related to the meson transverse size, and at higher $Q^2$ accesses color transparency. While $b$ is well studied for the helicity averaged case, there exists no previous experimental data regarding the $\rho^0$ helicity dependence. The HERMES data suggests a sizeable difference in the values of $b$ (and thus the transverse size of the $\rho^0$) for different helicities and a sizeable decrease of $b$ with increasing $Q^2$, an effect known as shrinkage.

2:24PM HG.00003 Simulations of Lepton-Hadron Discrimination in pp Collisions at Forward Rapidity with the STAR Detector at RHIC, B.S. PAGE, Indiana University, STAR COLLABORATION — In the coming years STAR will be measuring flavor separated polarized anti-quark distribution functions by studying the reaction $q + \bar{q} \rightarrow W^{\pm} \rightarrow e^\pm \nu$ in polarized pp collisions at $\sqrt{s} = 500$ GeV. Detection of high $p_T$ charged leptons with the Endcap Electromagnetic Calorimeter (EEMC) in the presence of a large hadronic background presents a significant challenge. To develop a hadron background rejection algorithm, we produced a series of Pythia simulations of W signal and QCD background events using GEANT and the full detector model. Pre-selection of those Pythia events likely to pass our triggers allowed for the generation of a background sample with an integrated luminosity comparable to that of the expected data. The rejection algorithm itself is based on three principles: isolation conditions on energy and tracks around the candidate electron, vetoes on energy and tracks opposite in azimuth from the candidate electron, and the properties of longitudinal and transverse shower development in the EEMC. This talk will detail the rejection algorithm which achieves a signal to background ratio of greater than one to one over a large fraction of the detected lepton energy spectrum.

2:36PM HG.00004 Cross-section measurement of the $\gamma n \rightarrow \pi^- p$ process from deuterium, WEI CHEN, THE CLAS COLLABORATION — Photopion production from nucleons are essential probes of the transition from meson-nucleon degrees of freedom to quark-gluon degrees of freedom in exclusive processes. There are few previous measurements of $\pi^-$ photo-production above photon energies of 2 GeV. Data taken during the CLAS g10 running period cover a significantly extended range of kinematics. We carried out an analysis of the $\gamma n \rightarrow \pi^- p$ process for photon energies between 1 to 3.5 GeV and pion center-of-mass angles between 50° to 150°. Preliminary results are extracted and will be presented in this talk.

1This work is supported in part by the U.S. Department of Energy.
and test results obtained with a full scale prototype will be presented.

In the tracking region, the straw tubes will be 1.5 m long and the chamber will consist of 24 layers (16 axial + 8 stereo). The current status of this detector spans the four-momentum transfer range 0.25 < Q^2 < 4.0 (GeV/c)^2 which is full Q^2 range for two running periods. ROSEN07, however, being the second period, focused on higher Q^2 range above 2 (GeV/c)^2. The Rosenbluth separation technique will be used to separate longitudinal and transverse cross sections to extract structure functions F_1, F_2, F_3, and R. This experiment is the second part of the first global survey of these fundamental quantities on deuteron which began with the Hall C experiment E02-109. The measurement of these fundamental quantities allows a variety of physics issues to be addressed, including: an evaluation of QCD moments of the deuteron and neutron structure functions, and quark-hadron duality in deuteron. This experiment was completed in July 2007 using the High Momentum Spectrometer to detect electrons from a 4 cm deuteron target. An overview will be presented of the experiment and analysis, along with preliminary results.

One of the main goals of the GlueX experiment is to map out the hybrid meson spectra. The CDC has to be able to track charged particles with relative large polar angles (6-165 degrees) in a solenoid magnetic field of 2.24 T. Also, this detector has to perform particle identification: to separate pions from protons in the calorimeter readout based on simulation and data taken with a prototype 12-bit, 250 MHz flash ADC.

The GlueX Central Drift Chamber (CDC) is a cylindric detector located close to a liquid hydrogen cell as a part of the GlueX spectrometer in Hall-D at Jefferson Lab. It is designed to track charged particles originating from a 12 GeV polarized photon beam impinging on a liquid hydrogen target. One of the main goals of the GlueX experiment is to map out the hybrid meson spectra. The CDC has to be able to track charged particles with relative large polar angles (6-165 degrees) in a solenoid magnetic field of 2.24 T. Also, this detector has to perform particle identification: to separate pions from protons in a momentum range up to 450 MeV/c. To fulfill these tasks the GlueX collaboration opted for a straw tube chamber because this option minimizes the material in the tracking region. The straw tubes will be 1.5 m long and the chamber will consist of 24 layers (16 axial + 8 stereo). The current status of this detector and test results obtained with a full scale prototype will be presented.
2:36PM HH.00004 Level-1 Trigger and DAQ system of the GlueX experiment, ALEXANDER SOMOV, Jefferson Lab, GLUEX COLLABORATION — The goal of the GlueX detector at Jefferson Lab is to study fundamental questions of the quantum chromodynamics, i.e., the nature of confinement of gluons and quarks. The detector’s design is optimized to measure the spectrum of exotic mesons that are expected to be produced in interactions of 8.4 - 9.0 GeV linearly polarized photons with a liquid hydrogen target. The GlueX trigger and DAQ electronics is based on pipelined TDC boards and FADC boards running at a 250 MHz clock. The trigger logic is implemented on special purpose programmable electronics boards with Field-Programmable Gate Array chips. Two types of boards are used: Crate Trigger Processors and Global Trigger Processors. All trigger electronics is hosted in VXS crates. The Level-1 trigger should reduce the 200 MHz electromagnetic rate and the 400 kHz hadronic rate to 200 kHz total rate. The trigger algorithm makes use of a measurement of the energy deposition in two electromagnetic calorimeters and hit counts in the time-of-flight detector and the tagger hodoscopes. We will present the trigger and DAQ design of the GlueX experiment and describe the Level-1 trigger algorithm in detail.

2:48PM HH.00005 Optimization of Performance Parameters for Large Area Silicon Photomultipliers, KATHRYN JANZEN, University of Regina — The goal of the GlueX experiment is to search for exotic hybrid mesons as evidence of gluonic excitations in an effort to better understand confinement. A key component of the GlueX detector is the electromagnetic barrel calorimeter (BCAL) located immediately inside a superconducting solenoid of approximately 2.5T. Because of this arrangement, traditional vacuum photomultiplier tubes (PMTs) which are affected significantly by magnetic fields cannot be used on the BCAL. The use of Silicon photomultipliers (SiPMs) as front-end detectors has been proposed. While the largest SiPMs that have been previously employed by other experiments are 1 x 1 mm², GlueX proposes to use large area SiPMs each composed of 16 - 3 x 3 mm² cells in a 1 x 4 array. This puts the GlueX collaboration in the unique position of driving the technology for larger area sensors. In this talk I will discuss tests done in Regina regarding performance parameters of prototype SiPM arrays delivered by SensL, a photonics research and development company based in Ireland, as well as sample 1 x 1 mm² and 3 x 3 mm² SiPMs.

3:00PM HH.00006 The GlueX Forward Drift Chambers, SIMON TAYLOR, Jefferson Lab, GLUEX COLLABORATION — The 12 GeV upgrade program at Jefferson Laboratory calls for the construction of a new experimental hall that will house a large-acceptance detector designed to study the excitation of the gluonic field binding quark–anti-quark pairs into mesons produced by a photon beam running at a tagged rate of 10⁷ γ/s. The GlueX detector is based on a large solenoid magnet that will enclose a lead/scintillating fiber calorimeter for detection of photons and drift chambers for tracking charged particles. The paths of particles traveling in the 1° – 20° angular range downstream of the target will be measured by a set of cathode strip chambers consisting of wire planes flanked by cathode planes divided into strips, enabling precision measurements of avalanche positions along the wires. The coordinate transverse to the wire is determined using the drift time. The combination of wire and cathode readout allows for reconstruction of “space points” at several positions along the beam line. I will present results from extensive studies of a small-scale prototype of one cathode strip chamber unit and discuss issues arising from operation within a large magnetic field.

3:12PM HH.00007 Performance of the prototype module of the GlueX electromagnetic barrel calorimeter, ZISIS PAPANDREOU, BLAKE LEVERINGTON, GEORGE LOLOS, University of Regina, GLUEX COLLABORATION — A photon beam test of the 4 m long prototype lead/scintillating fibre module for the GlueX electromagnetic barrel calorimeter was carried out in Hall B at the Thomas Jefferson National Accelerator Facility with the objective of measuring the energy and timing resolutions of the module as well as the number of photoelectrons generated. Data were collected over an energy range of 150 to 650 MeV at multiple positions and angles along the module. Details of the analysis at the centre of and perpendicular to the module will be presented.

3:24PM HH.00008 Beam Position Stabilization Using an Active Collimator in Hall D at Jefferson Lab, RICHARD JONES, IGOR SENDEROVICH, University of Connecticut, GLUEX COLLABORATION — The GlueX experiment planned for Hall D at Jefferson Lab relies on the process of coherent bremsstrahlung by 12 GeV electrons in a diamond crystal to produce a secondary beam of 9 GeV photons with a high degree of linear polarization. To achieve optimum polarization, the photon beam must be collimated to a half-angle of 20°. A active collimator has been designed which is capable of monitoring the centroid of the photon beam to within ±200 μm, with a sampling frequency of up to several hundred Hz. A prototype of this device has been tested in the photon beam in Hall B. Results from this test are presented.

Sunday, October 26, 2008 8:30AM - 10:18AM –
Session LA Frontiers in Rare Isotope Science
Simmons Ballroom 2-3

8:30AM LA.00001 β decay of N=Z isotopes ⁹⁶Cd, ⁹⁸In and ¹⁰⁰Sn, DANIEL BAZIN, National Superconducting Cyclotron Laboratory — The β-decay properties of the N=Z isotopes ⁹⁶Cd, ⁹⁸In and ¹⁰⁰Sn have been studied. The isotopes were produced at the National Superconducting Cyclotron Laboratory (NSCL) by fragmenting a 120 MeV/u ¹¹²Sn primary beam in a Be target. The resulting radioactive beam was filtered in the A1900 and the newly commissioned Radio Frequency Fragment Separator to achieve a purity level suitable for decay studies. The observed production cross sections of these isotopes are lower than expected by factors of 10 to 30. The ¹⁰⁰Sn cross section is 0.25(15) pb. In sharp contrast with the 120 pb lower limit established at 63 MeV/u incident energy of the same primary beam. The half-life of ⁹⁶Cd, which was the last experimentally unknown waiting point half-life of the astrophysical r-process, is 1.03±0.23 s. The implications of the experimental T1/2 value of ⁹⁶Cd on the abundances predicted by the r-process and the origin of A≈96 isotopes such as ⁹⁶Ru are explored. The measured half-lives of ⁹⁶In are 47(13) ms and 0.66(40) s, and 0.55±0.70 -0.31 s for ¹⁰⁰Sn. They are in agreement with previous determinations and lead to an improved precision.

This work is supported by NSF grants PHY02-16783 and PHY-06-06007.
9:06AM LA.00002 New decay studies near the doubly-magic $^{78}\text{Ni}\text{)}$, KRYSZTOF RYKACZEWSKI, ORNL

Physics Division — The nucleus $^{78}\text{Ni}$, with a closed proton shell at $Z=28$ and a closed neutron shell at $N=50$, is the most neutron-rich doubly-magic nucleus identified to date [1,2]. Spectroscopic studies of nuclei around $^{78}\text{Ni}$ are important for understanding both the evolution of nuclear structure in neutron rich matter and the rapid neutron capture nucleosynthesis process. Additionally, the beta-delayed neutron emission from neutron-rich fission products contributes to the total number of neutrons inducing fission in nuclear fuel and should be accounted for when running power reactors. The neutrons filling the large $1g_{9/2}$ shell between $N=40$ and $N=50$ impact the spin-orbit splitting of the respective proton orbital pairs, $2p_{1/2}/2p_{3/2}$ and $1f_{7/2}/1f_{5/2}$. This can trigger a change in the ground-state proton configuration of very neutron rich nuclei above $Z=28$ [3,4]. Further, the energy difference between the $2d_{5/2}$ and $3s_{1/2}$ neutron orbitals above $N=50$ is decreasing when approaching the $^{78}\text{Ni}$ region possibly resulting in the appearance of a new subshell closure at $N=58$. Nuclei in the $^{78}\text{Ni}$ region are produced at the Holifield Radioactive Ion Beam Facility (HRIBF, Oak Ridge National Laboratory) by means of an on-line isotope separation technique using the fission of a $^{238}\text{U}$ target induced by a 50 MeV, 10 microAmp proton beam. The decay studies performed at the HRIBF profitted from the post-acceleration of mass-separated radioactive beams to about 200 MeV. A novel method, the so-called *ramping-out* technique, allowed us to separate the most neutron-rich component of the isobaric cocktail beam [5,6]. New results on the decay of $A=76$ to $A=79$ Cu isotopes and of $A=83$ to $A=85$ Ga isotopes will be presented. In particular, the measured beta-delayed neutron branching ratios for the Cu isotopes are two to four times larger than previously reported [7]. An energy of 247 keV was established for the $3s_{1/2}$ neutron state above the $2d_{5/2}$ ground- state in the N=51 isotope $^{83}\text{Ge}$ suggesting the existence of low energy E2 isomers in the N=51 $^{81}\text{Zn}$ and $^{79}\text{Ni}$ nuclei. The low-energy $3s_{1/2}$ state may have a spatially extended wave function (halo) in a weakly bound N=53 isotope $^{81}\text{Ni}$. The extension of the HRIBF studies to even more neutron-rich nuclei at the recently completed Low-energy Radioactive Ion Beam Spectroscopy Station will also be discussed. [1] Ch.Engelmann et al., Zeit. Phys. A 352, 351 (1995) [2] P.T.Hosmer et al., Phys. Rev. Lett. 94, 112501 (2005) [3] T.Otsuka et al., Phys. Rev. Lett. 95, 232502 (2005) [4] J.Dobaczewski et al., Prog. Nucl. Part. Phys. 59,432(2007) [5] C. J. Gross et al., Eur. Phys. Jour. A25, s01, 115 (2005) [6] J. A. Winger et al., Acta Phys. Pol. B39, 525 (2008) [7] B. Pfeiffer et al., Prog. Nucl. Energy 41, 39 (2002)

1 ORNL is managed by UT-Battelle for U.S. DOE under contract DE-AC05-00R22725

Supported by the NSF Grants PHY-0555366 and PHY-0758099 and a Grant from the Binational Science Foundation USA-Israel.

9:42AM LA.00003 Ab initio many-body calculations of light nuclei neutron and proton scattering, SOPHIA QUAGLIONI, Lawrence Livermore National Laboratory — One of the greatest challenges of nuclear physics today is the development of a quantitative microscopic theory of low-energy reactions on light nuclei. At the same time, technical progress on the theoretical front is urgent to match the major experimental advances in the study of exotic nuclei at the radioactive beam facilities. We build a new *ab initio* many-body approach [1] capable of describing simultaneously both bound and scattering states in light nuclei, by combining the resonating-group method [2] with the *ab initio* no-core shell model [3]. In this way, we complement a microscopic-cluster technique with the use of realistic interactions, and a microscopic and consistent description of the nuclear clusters, while preserving Pauli principle and translational symmetry. We will present results for neutron and proton scattering on light nuclei, including $n$- and $p$-He phase shifts, and low-lying states of one-neutron halo $p$-shell nuclei, obtained using realistic nucleon-nucleon potentials. In particular, I will address the parity inversion of the $^{11}\text{Be}$ ground state.

1 Prepared by LLNL under Contract De-AC52-07NA27344. Support from the U.S. DOE/SC/NP (Work Proposal No. SCW0498), and from the U. S. Department of Energy Grant DE-FC02-07ER41457 is acknowledged.


Sunday, October 26, 2008 8:30AM - 10:06AM – Session LB Nuclear Theory: Fundamental Issues Room 208

8:30AM LB.00001 What can cold atomic gases teach us about nuclear structure?, CALVIN JOHNSON, PLAMEN KRASTEY, JOSHUA STAKER, San Diego State University — Cold atomic gases have become a new frontier for applying many-body techniques. We look at computing the ground state of a trapped gas of fermionic atoms using configuration-interaction shell-model methods, with attention paid to convergence. Most notably we consider gases with infinite scattering length and with zero- and finite-ranges, and discuss what lessons nuclear structure theorists can take home.

1supported by US Department of Energy

8:42AM LB.00002 The energy spectrum of three protons trap systems, SHALVA TSIKLAURI, ROMAN KEZERASHVILI, Physics Department, New York City College of Technology, CUNY, Brooklyn, NY, USA — This paper consider possibility that three proton may bind in uniform strong magnetic field. We have used hyperspherical functions method for solution of the relative part Hamiltonian of three protons confined in the presence of an applied uniform magnetic field. The spin singlet-triplet transition in the ground state of the three protons is shown. We have also displayed the singlet-triplet energy gap, $\Delta = E_T - E_S$, against the strength of the magnetic field.

8:54AM LB.00003 Amplification of weak interaction by coherent effects in the nucleus, VLADIMIR ZELEVINSKY, Michigan State University, NAFTALI AUERBACH, Tel Aviv University, ALEXANDER VOLYA, Florida State University — Strong interactions between the nucleons in complex nuclei can considerably amplify the effects of weak perturbations. The parity non-conservation in experiments with slow polarized neutrons (scattering and fission) is enhanced by orders of magnitude as a result of high density of neutron resonances and uniformly chaotic nature of compound wave functions. The search for the electric dipole moments (EDM) of atoms is currently performed by several experimental groups. Here one needs a coherent enhancement of simultaneous parity and time-reversal violation in the ground state. The atomic EDM is induced by the nuclear Schiff moment. We discuss possible mechanisms of the enhancement of the Schiff moments by the coherent interaction of quadrupole and octupole degrees of freedom in deformed nuclei and in soft spherical nuclei.

1Supported by the NSF Grants PHY-0555366 and PHY-0758099 and a Grant from the Binational Science Foundation USA-Israel.
9:06AM LB.00004 Nuclear Electric Dipole Moment of $^3$He 1. STETCU, Los Alamos National Laboratory, C.-P. LIU, Univ. of Wisconsin, J. FRIAR, A. HAYES, Los Alamos National Laboratory, P. NAVRATIL, Lawrence Livermore National Laboratory — A permanent electric dipole moment (EDM) of a physical system requires time-reversal (T) and parity (P) violation. Experimental programs are currently pushing the limits on EDMs in atoms, nuclei, and the neutrino to regimes of fundamental theoretical interest. Here we calculate the magnitude of the PT-violating EDM of $^3$He and the expected sensitivity of such a measurement to the underlying PT-violating interactions. Assuming that the coupling constants are of comparable magnitude for pi-, rho-, and omega-exchanges, we find that the pion-exchange contribution dominates. Our results suggest that a measurement of the $^3$He EDM is complementary to the planned neutron and deuteron experiments, and could provide a powerful constraint for the theoretical models of the pion-neutron PT-violating interaction.

9:18AM LB.00005 Calculation of Observables using the SRG Flow Equations1, E.R. ANDERSON, Ohio State University, S.K. BOGNER, Michigan State University, R.J. FURNSTAHL, E.D. JURGENSON, R.J. PERRY, Ohio State University — The Similarity Renormalization Group (SRG) flow equations are a series of unitary transformations which can be used to to achieve different patterns of decoupling in a Hamiltonian. An SRG transformation applied to nucleon-nucleon interactions leads to greatly improved convergence properties while preserving observables. Not only does it provide a method to consistently evolve many-body potentials, but also other operators. Here, the flow equations are applied to model and realistic nuclear Hamiltonians to calculate various observables (via the Stochastic Variational Method). Analytic properties of the corresponding operators are explored as well as properties of the general unitary transformation applied to these operators.

1Supported in part by the NSF under Grants Nos. PHY-0354916 and PHY-0653312, and the UNEDF SciDAC Collaboration under DOE Grant DE-FC02-07ER41457.

9:30AM LB.00006 Similarity Renormalization Group with Three-Body Forces in One-Dimensional Models1, E. JURGENSON, RICHARD FURNSTAHL, Ohio State University — Similarity Renormalization Group (SRG) flow equations have been applied to nucleon-nucleon interactions, resulting in band-diagonalized Hamiltonians. This decouples high- and low-energy states, which greatly simplifies many-body calculations. Further progress requires a consistent application of the SRG to at least three-nucleon interactions. In this talk we present model calculations in one dimension including the evolution of three and four body forces with the SRG flow equations. We perform our calculations with several different approaches in anticipation of the three-dimensional generalization.

1Supported by the National Science Foundation under grant nos. PHY-0354916 and PHY-0653312, and the UNEDF SciDAC Collaboration under DOE Grant DE-FC02-07ER41457.

9:42AM LB.00007 Law of Matter Creation and Motion, STEWART BREKKE1, Northeastern Illinois University(former grad student) — All matter is in a state of no motion, linear, rotational and/or vibratory motion. Therefore, matter, when created, will have no motion, linear, rotational and/or vibratory motion singly and/or in some combination. Curvilinear motion such as orbital motion is linear motion in an external force field. If $1/2I\omega^2$ is the energy of rotation and $k$ is a constant of vibration and $x$ the amplitude of vibration, the equation for this law of matter creation and creation of energy of motion is $hf = 2mc^2 + 1/2mv^2 + 1/2m_kv^2 + 1/2I\omega^2 + 1/2I\omega^2 + 1/2kx^2 + 1/2kx^2$

1prev. paper at Mar08 Meeting

9:54AM LB.00008 The Brightsen Nucleon Cluster Model Predicts Unmatter Entities inside Nuclei. DMITRI RABOUNSKI, FLORENTIN SMARANDACHE, University of New Mexico, Gallup — The basis that “unmatter” (the conjugations of matter and antimatter) does exists comes from the 1970’s experiments done at Brookhaven and CERN (Phys. Rev. Lett., 1971, v.26, 1491; 1974, v.32, 247; 1974, v.33, 1635; Phys.-Usr., 1973, v.109, 431; Ann. Phys., 1974, v.84, 261), where unstable unmatter-like entities were found. The term “unmatter” was first introduced by Smandache in 2004 (CERN CDS EXT-2004-142), and then in (Prog. Phys., 2005, v.1, 9; 2005, v.2, 113). Applying the Brightsen Nucleon Cluster Model of the atomic nucleus we claim that unmatter entities may be formed as clusters inside a nucleus. This model supports an idea that antimatter nucleon clusters are present as a paragon superposition within the spatial confinement of the proton (1H1), the neutron, and the deuteron (1H2). If model predictions can be confirmed in experiment, a new physics is suggested, opening a way to expand the Standard Model.

Sunday, October 26, 2008 8:30AM - 10:18AM —  Session LC Neutrino Physics: Instrumentation  I  Jewett Ballroom A-B

8:30AM LC.00001 Water Cerenkov Detection of Neutrinos and Neutrons1, MELINDA SWEANY, UC Davis, STEVEN DAZELEY, ADAM BERNSTEIN, NATHANIEL BOWDEN, LLNL, ROBERT SVOBODA, UC Davis — Special Nuclear Material (SNM) emits both neutrons and high energy gamma-rays via spontaneous or induced fission. The detection of these signatures within cargo containers has recently become a high priority area of study. Both forms of radiation are highly penetrating and likely to defeat some degree of effective shielding. The advanced detector group at LLNL has been actively developing the technology for water based neutron detection as part of this effort. Key aspects of our work have grown out of the advanced detector development over time. We have built and deployed a small prototype Gadolinium Tri-Chloride doped water Cerenkov detector and tested it with a $^{232}$Th source. We have also carried out R&D on the attenuation length of $\text{GdCl}_3$ doped water, as well as its effects on likely detector components. We will discuss these results and our plans for the near future.

1This work was performed under the auspices of the US Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344.

8:42AM LC.00002 Precision microwave detection of beta-decay electrons. BENJAMIN MONREAL, JOSEPH FORMAGGIO, ASHER KABOTH, Massachusetts Institute of Technology — In order to measure the electron neutrino mass via the tritium beta-decay endpoint, we require extremely precise energy measurements of mildly relativistic electrons. In a magnetic field, these electrons emit coherent cyclotron radiation. Detecting this radiation gives a repeatable, nondestructive measurement of single electron energies and velocities; this may make possible a novel high-precision, low-background tritium experiment, and may have applications in other areas of nuclear physics. In this talk, we outline such an experiment. We discuss some practical aspects of single-electron detection at microwave frequencies, and simulations of the ultimate energy resolution and neutrino-mass sensitivity.
COLLABORATION — This talk will cover key aspects of the LENS detector that will be tested by MiniLENS, an ∼ through liquid-liquid extraction. The key properties of the InLS are high metal loading (8-10%), long attenuation length at 430nm (event location instead of the usual time of flight method. LENS requires approximately 10 tons of Indium to be loaded into 100,000 L of organic scintillator, as aspects that will be tested in MiniLENS are the novel scintillation lattice (SL), the Indium loaded liquid scintillator (InLS) production and the background filter, and the detector, as well as a detailed measurement of the scattering cross sections of electrons on molecular tritium. We will give an overview of the Karlsruhe Tritium Neutrino (KATRIN) experiment is a next generation tritium beta decay experiment designed to measure directly the electron neutrino mass with a sensitivity of 0.2 eV. In the experiment, electrons from tritium decay of a gaseous source are magnetically guided through solenoidal retarding electrostatic spectrometers and detected via a focal plane detector. The focal plane detector is a 90nm diameter, 500 micron thick monolithic silicon pin-diode array with 148 pixels. The diode contacts have a titanium nitride overlayer and are connected to preamplifiers via an array of spring-loaded pogo pins. This novel connection scheme minimizes backgrounds from radioactive materials near the detector, facilitates characterization and replacement of the detector wafer, but requires a unique mounting design. The force of the pins strains the silicon, possibly altering the detector properties and performance. Results on the mechanical, thermal and electrical performance of a prototype detector under stress from pogo pin readouts will be presented.

Massachusetts Institute of Technology, KATRIN COLLABORATION — The Karlsruhe Tritium Neutrino (KATRIN) experiment is a tritium beta decay experiment designed to make a direct, model independent measurement of the electron neutrino mass. To accomplish this task, the experiment employs precisely defined electric and magnetic fields for particle transport and mass spectroscopy. In order to simulate particle trajectories in the experiment, it is essential to have methods for calculating these fields quickly and accurately. The application of the methods of direct elliptic integral calculation, zonal harmonic expansion and interpolation from an adaptive-refinement field mesh is described, as well as an analysis of their comparative strengths and weaknesses in reproducing the electromagnetic fields found in KATRIN.

Electromagnetic Field Simulation in the KATRIN experiment, THOMAS CORONA, Massachusetts Institute of Technology, KATRIN COLLABORATION — Over the past decade, experiments studying neutrinos from atmospheric, solar, and reactor sources have shown conclusively that neutrinos change flavor and, as a consequence, have a small but finite mass. Yet, the scale of neutrino masses remains an open question that is of great importance for many areas of physics. The Karlsruhe Tritium Neutrino (KATRIN) experiment is the next generation tritium beta decay experiment with sub-eV sensitivity to make a direct, model independent measurement of the electron neutrino mass, with a projected sensitivity of 200 eV. This measurement requires a high level of stability in all spectrometer systems, including the source, the electromagnetic filter, and the detector, as well as a detailed measurement of the scattering cross sections of electrons on molecular tritium. We will give an overview of the some of the calibration techniques employed by the experiment necessary to attain its final sensitivity.

Basic Technologies for MiniLENS and LENS1, STEVEN D. ROUNTREE, Virginia Tech, LENS COLLABORATION — This talk will cover key aspects of the LENS detector that will be tested by MiniLENS, an ∼100L indium loaded detector. The key aspects that will be tested in MiniLENS are the novel scintillation lattice (SL), the Indium loaded liquid scintillator (InLS) production and the background suppression techniques made viable the SL. In addition to background suppression, the pp signal will be tested by “proxy” events using muon pretagged (p,n) reactions which have the same post tag cascade as InLS (nu, e). LENS requires spatial resolution of ~10cm to exploit the signature from neutrino capture on In115 and suppress the background due to In115 beta decay. To obtain this spatial resolution we have developed an optically segmented cubic lattice (SL) of low index foils in a relatively high index scintillator. This system creates a pixilated light output on the sides of the detector which allows for digital event location instead of the usual time of flight method. LENS requires approximately 10 tons of Indium to be loaded into 100,000 L of organic scintillator, through liquid-liquid extraction. The key properties of the InLS are high metal loading (8-10%), long attenuation length at 430nm (>8m), high scintillation yield, stability on the scale of 5 years, and low environmental and health hazards in an underground ambience.

1This work was funded in part by NSF.

A Novel Point Contact HPGe Detector for Searching for Neutrinoless Double-Beta Decay, VICTOR M. GEHMAN, Los Alamos National Laboratory, MAJORANA COLLABORATION — The MAJORANA collaboration is investigating a new design for high-purity germanium (HPGe) detectors that could increase the physics reach and decrease the cost of our next generation neutrinoless double-beta decay (0νββ) search. The p-type, point-contact (PPC) HPGe detector (that is, a detector with a very compact central contact geometry), has a number of very attractive characteristics which could do much to help the field of 0νββ, as well as the search for many other types of rare events. This new detector design allows for very low energy thresholds (potentially as low as 0.1 keV), and powerful background rejection through comparatively simple pulse shape analysis algorithms using only the digitized signal from the central contact. As with any new technology however, the PPC detectors must be characterized for reliability, robustness and reproducible fabrication. We present the present status of our efforts, with emphasis on one such detector, “MJ70” procured for the MAJORANA collaboration from PHDs Co. This detector is currently undergoing careful evaluation. This presentation will focus on the characterization program for PPCs, as well as how these detectors fit into the broader MAJORANA R&D program.

Geant4 simulation of backgrounds in a p-type point contact Ge detector array , M. BOSWELL, UNC/TUNL, ON BEHALF OF THE MAJORANA COLLABORATION — Plans are currently underway to construct an array of P-type Point Contact (PPC) Ge detectors for the MAJORANA neutrinoless double beta decay experiment. An important aspect of any ultra-low background detector design is estimating the background due to the detectors, associated small parts and cables, and the cryostat components. To this end, the current detector array design has been implemented in Geant4, and a detailed analysis of these backgrounds is underway. In the simulation, the individual components are activated with normal levels of impurities. The response of the detector array to these components provides an estimate of background contributions to the region of interest. Furthermore, analyzing the individual detector response to these various components will provide useful information for background cuts.

Sunday, October 26, 2008 8:30AM - 10:18AM — Session LD Mini-Symposium: Probing the Ridge in Ultra-Relativistic Heavy Ion Collisions Jewett Ballroom G-H
8:30AM LD.00001 Di-jet correlation tomography of ultrarelativistic nuclear collisions\(^1\), MIKL\O S GYULASSY, Columbia University — Moderate \(p_T\) hadrons associated with quenched jets in ultrarelativistic nuclear collisions at RHIC exhibit a puzzling pattern of correlations as a function of rapidity and azimuthal angle (the near side rapidity Ridge the away side Mach like double shoulder features). These patterns are expected to provide detailed differential in \(p_T\) information about the response of the strongly coupled Quark Gluon Plasma (sQGP) to rare but well calibrated high \(p_T\) jets. This talk presents an overview of current pQCD and AdS/CFT jet tomography models and possible interpretations of these observations.

\(^1\)Supported under DOE Grant DE-FG02-93ER40764

9:06AM LD.00002 Observation of a dramatic transition in the same-side \((\eta, \phi)\) correlation data from STAR, LANNY RAY, University of Texas at Austin, STAR COLLABORATION — Two-dimensional angular correlations on relative pseudorapidity \(\eta\) and azimuth \(\phi\) are presented for charged particles from Au-Au collisions at \(\sqrt{s_{NN}} = 62\) and 200 GeV, with transverse momentum \(p_T \geq 0.15\) GeV/c and \(|\eta| \leq 1\). Significant correlations are observed, including a peaked structure for same-side pairs (relative \(\phi < \pi/2\)) and a closely related away-side ridge. The same-side peak, associated with semihard parton scattering and fragmentation (minijets) in peripheral Au-Au and p-p collisions, follows binary-collision scaling in Au-Au collisions until mid-centrality where an abrupt transition to a qualitatively different centrality trend is observed. The transition (especially the large increase in \(\eta\) width) leads to a manifestation at lower \(p_T\) of the ridge phenomenon observed in trigger-associated particle correlations at higher \(p_T\). Above the transition the number of same-side correlated particles increases rapidly relative to binary-collision scaling. The transition point at both energies occurs at a common transverse density of \(\approx 2.5\) particles/unit-\(\eta/\text{fm}^2\). Our results contradict heavy ion collision scenarios which invoke rapid formation of an opaque, locally thermalized medium.

9:18AM LD.00003 Probing the medium response by two-particle correlations in Au+Au Collisions at \(\sqrt{s_{NN}} = 200\) GeV by the PHENIX Experiment, CHIN-HAO CHEN, Department of Physics and Astronomy, Stony Brook University, PHENIX COLLABORATION — PHENIX has measured the two-particle inclusive photon-hadron \(\Delta \gamma - \Delta \phi\) correlations at intermediate \(p_T\). We decompose the away-side into a head region corresponding to the jet remnant which punches through the medium, and the shoulder, which contains the medium response. We report the per trigger yield of correlated particles in the two away-side components as well as in the trigger jet and near-side ridge in pseudorapidity. In order to study momentum flow between the jet and the medium, we weight the associated particle yields with transverse momentum, and compare the \(p_T\) flow of the different components of the correlation function.

9:30AM LD.00004 Transition in same-side \((\eta, \phi)\) correlation for Cu-Cu data from STAR, DUNCAN PRINDLE, STAR TEAM — Two-dimensional angular correlations on relative pseudorapidity \(\eta\) and azimuth \(\phi\) are presented for charged particles from Cu-Cu collisions at \(\sqrt{s_{NN}} = 62\) and 200 GeV, with transverse momentum \(p_T \geq 0.15\) GeV/c and \(|\eta| \leq 1\). For Au-Au data we observe a number of significant structures, including a peaked structure for same-side pairs (relative \(\phi < \pi/2\)) and a closely related away-side ridge. That peak follows binary-collision scaling in Au-Au until mid-centrality where an abrupt transition to a qualitatively different centrality trend is observed, leading to a manifestation at lower \(p_T\) of the ridge phenomenon observed in trigger-associated particle correlations at higher \(p_T\). Here we present results using the same analysis technique but on Cu-Cu collisions at \(\sqrt{s_{NN}} = 62\) and 200 GeV. Here we also observe a same-side peak and away side ridge. We focus on a comparison of the centrality trend of transition points in Cu-Cu to that of corresponding transitions previously observed in Au-Au.

9:42AM LD.00005 Onset of collective flow due to Weibel instabilities\(^1\), JORGEN RANDRUP, Lawrence Berkeley National Laboratory, USA, STANISLAW MIROWCZYNSKI, Soltan Institute for Nuclear Studies, Warsaw, and Institute of Physics, Swietokrzyska Academy, Kielce, Poland — Since the local momentum density is highly anisotropic at the early stage of an ultra-relativistic nuclear collision, it is expected that Weibel instabilities will generate color currents with a characteristic (preferentially transverse) vector wave. As demonstrated first by Ampère, different currents repel and in the SU(3) plasma there is therefore a net tendency for the Weibel currents to experience a mutual repulsion. This feature is phenomenologically important since the associated increase of the pressure provides a mechanism for the early development of collective flow. For the purpose of establishing a framework for examining this effect, we have extended our earlier work to encompass the evolving correlation function for the local momentum density. Starting from the fluctuations in a free gas of gluons, quarks and anti-quarks, we treat the self-consistent feedback of the amplified chromodynamic fields on the phase-space densities.

\(^1\)Supported in part by the Director, Office of Energy Research, Office of High Energy and Nuclear Physics, Nuclear Physics Division of the U.S. Department of Energy under contract No. DE-AC03-76SF00098.

9:54AM LD.00006 Measurements of Differential Transverse Momentum Correlation Function from the STAR Experiment, MONIKA SHARMA, Wayne State University, Detroit, MI, USA, STAR COLLABORATION — The event anisotropy measurements at RHIC have revealed that the matter created in heavy ion collisions flows with very little viscosity. The estimation of ‘viscosity-to-entropy’ ratio is currently a subject of extensive study [1]. In order to find quantitative experimental information on the viscosity of the medium we present measurements of differential transverse momentum correlation function from the STAR experiment in \(Au + Au\) collisions at \(\sqrt{s_{NN}} = 200\) GeV. We study the correlation function of the particles as a function of pseudo-rapidity and azimuthal angle in the range \(0.2 < \eta < 2.0\) GeV/c at mid rapidity \(|\eta| < 1.0\) for various centralities. This measurement also enables a study of the ‘soft-ridge’ effect. Reference: [1] S. Gavin and M. Abdel-Aziz, Phys. Rev. Lett. 97 (2006) 162302.

10:06AM LD.00007 Constraining the Geometry to Study Jet Energy Loss with “2+1” correlations in PHENIX, HUA PEI, Iowa State University, PHENIX COLLABORATION — The RHIC at BNL collides heavy nuclei to create a medium at unprecedented density and temperature, commonly known as Quark Gluon Plasma (QGP). Jets of hadrons from quarks and gluons experiencing initial state hard scattering interact strongly with medium and provide a probe of momentum through the QGP that exists early in the collision. In back-to-back jets events, both partons survive to produce high-\(p_T\) hadrons, and the distribution of hard-scattering locations is likely different than the surface-bias that affects single-particle studies, hence provide a better understanding of energy loss, and constrain the plasmas properties. Achieving these goals requires that we control the path-length traveled by the partons as much as possible and observables that are sensitive to the amount of energy loss of partons. We require a high-\(p_T\) hadron in the back-hemisphere to the trigger particle, i.e., 2+1 particle correlations. We will present how correlations change as a function of these selection variables, and compare the Au+Au and Cu+Cu results with the baseline p+p results.

Sunday, October 26, 2008 8:30AM - 10:06AM –
Session LE Nuclear Structure: Light Nuclei Simmons Ballroom 1
A preliminary reduced transition matrix element spectrometer were used to detect deexcitation $\gamma$-rays in $^{12}$Be isotones. We have searched available experimental data for signatures of shell closures far from stability. These data are compared to $N$- and proton plays a pervasive role in the evolution of nuclear structure with changing neutron and proton number. With experimental data far from stability, Fallon, A.O. Macchinielli, Lawrence Berkeley National Laboratory — It has been known for a long time that the interaction between valence neutrons and protons is responsible for the collective behavior of nuclear states. The shell model provides a framework for understanding the properties of nuclear states and their evolution with changing neutron and proton number. The $N$- and proton are important in the evolution of nuclear structure with changing neutron and proton number. We have developed a microscopic cluster model of light two neutron halo nuclei that incorporates the few-body asymptotics in full extent. The wavefunction of the system consists of a core and two neutron components. The microscopic description of the core allows us to test the efficiency of Pauli projection techniques employed in the few-body models. We have presented and discussed in terms of recent ab-initio calculations. This research is supported by the DOE Office of Nuclear Physics under contract DE-AC02-06CH11357.

8:42AM LE.00002 Improved DSAM measurements in $^{10}$Be as a test of Ab-Initio calculations
E.A. Mccutchan, C.J. Lister, M.P. Carpenter, R.V.F. Janssens, T.H. Kho, T. Lauritsen, D. Severnyiak, I. Stefanescu, S. Zhi, Argonne National Laboratory — Recent ab-initio calculations in light nuclei have emphasized the significance of 3-body forces. In the A = 10 systems, the inclusion of 3-body forces inverts the sequence of states, which has been attributed to the important contribution of the 3-body interaction to the overall spin orbit force. To challenge these latest calculations, a new generation of improved DSAM measurements is necessary to precisely ($\sim5\%$) determine matrix elements between excited states. Lifetimes of excited states in $^{10}$Be, populated in the $^6$Li($^7$Li,n) reaction, are determined using high velocity DSAM measurements. The recoiling $^{10}$Be were detected at zero degrees using the Argonne Fragment Mass Analyzer (FMA) and $\gamma$ rays measured with Gammasphere, the combination allowing for the collection of very clean $\gamma$-ray spectra and the elimination of cascade feeding. Preliminary results of the experiment will be presented and discussed in terms of recent ab-initio calculations. This work was supported by research grants from the Department of Energy.

8:54AM LE.00003 $^{25}$Al levels observed in the $^{28}$Si(p,$\alpha$)$^{25}$Al reaction, S.T. Pittman, Univ. of Tenn., D.W. Bardayan, ORNL, J.C. Blackmon, LSU, R.L. Kozub, Tenn. Tech. Univ., M.S. Smith, ORNL — The level structure of $^{25}$Al has been studied at the ORNL Holifield Radioactive Ion Beam Facility (HRIBF) by measuring the angular and energy distributions of alpha particles from the $^{28}$Si(p,$\alpha$)$^{25}$Al reaction. Proton beams ($\sim10$ nA) at laboratory energies of 40- and 42-MeV, respectively, were generated by the 25 MV tandem accelerator and bombarded a natural silicon target ($50$ mg/cm$^2$). Alpha particles were detected and identified in the Silicon Detector Array (SIDAR) in the “telescope” configuration [1]. Angular distributions were extracted for strongly populated states, and distorted-wave Born approximation (DWBA) calculations were performed using the code DWUCK4 to determine spin and parity. Results of this experiment, including angular distributions of alpha particles and spin and parity assignments for $^{25}$Al excited states, will be discussed. [1] D.W. Bardayan et al., Phys. Rev. C 65, 032801(R) (2002). *This work was supported by research grants from the Department of Energy.

9:06AM LE.00004 Narrowing of the neutron sd-pf shell gap in $^{20}$Na$^+$, Aaron Hurst, Lawrence Livermore National Laboratory, TIGRESS COLLABORATION — The wave-function composition for the low-lying states in $^{20}$Na was explored by measuring their electromagnetic properties using the Coulomb-excitation technique. A beam of $^{20}$Na$^+$ ions, postaccelerated to 70 MeV, bombarded a $^{238}$U target with a rate of up to 600 particles per second, in the first physics experiment using the ISAC-II facility at TRIUMF. Six segmented clover detectors of the TIGRESS $\gamma$-ray spectrometer were used to detect $\gamma$ rays in coincidence with scattered or recoiling charged particles in the segmented silicon detector, BAMBINO. A preliminary reduced transition matrix element $\langle l \mid E2 \mid \frac{2}{3}^+ \rangle = 0.229(20) \mu$b was derived for $^{20}$Na from the measured $\gamma$-ray yields for both projectile and target. This first-time measured value is consistent with the most recent Monte Carlo shell-model calculation (MCSM) of Utsuno et al., predicted to be $0.232 \mu$b, indicating an approximately equal admixture of both sd and pf components in the wave function, and also providing evidence for the narrowing of the sd-pf shell gap from $\sim6$ MeV for stable nuclei to $\sim3$ MeV for $^{20}$Na.

9:18AM LE.00005 Z=14 and Z=16 shell closures$^1$, Mathis Wiecking, Lawrence Livermore National Laboratory, P. Fallone, A.O. Macchiaveli, Lawrence Berkeley National Laboratory — It has been known for a long time that the interaction between valence neutrons and protons plays a pervasive role in the evolution of nuclear structure with changing neutron and proton number. With experimental data far from stability, becoming available we present a systematic investigation of experimental excitation energies and electromagnetic properties in nuclei along the N=$10$, 11, and 12 isotones. We have searched available experimental data for signatures of shell closures far from stability. These data are compared to $N$- and $N_2$ models and are found to be consistent with the proposed proton shell closures at Z=14 [1] and Z=16 [2]. [1] P.D. Cottle, Phys. Rev. C 76, 027301 (2007) [2] Z. Dlouhy et al., Nucl. Phys. A722, 36 (2003).

9:30AM LE.00006 A microscopic hyper-spherical model: application to $^6$He$^1$, Ivan Brida, Filomena Nunes, NSCL and Department of Physics and Astronomy, Michigan State University, East Lansing MI 48824 — We have developed a microscopic cluster model of light two neutron halo nuclei that incorporates the few-body asymptotics in full extent. The wavefunction of the system consists of a core and two valence neutrons. The core is given in terms of correlated Gaussians. The three-body dynamics between the core and valence neutrons are taken into account by means of the hyper-spherical functions containing an exponentially decaying hyper-radial part. The center of mass motion is removed by construction. In this talk, we present the first results of our model applied to $^6$He. The central Minnesota N-N interaction with a spin-orbit addition is used to bind the system. Basic structural observables, such as binding relative to $^4$He, radii, and one-body densities are in agreement with other microscopic calculations employing similar N-N interactions. The microscopic description of the core allows us to test the efficiency of Pauli projection techniques employed in the few-body models. We demonstrate that proper antisymmetrization is crucial to bind $^6$He against three-body break-up. We also present overlap functions between $^4$He and $^6$He with the aim of future reaction calculations.

$^1$This work was supported by the DOE, LLNL Contract DE-AC52-07NA27344, the NSF, the NSERC of Canada, and the STFC of the UK. TRIUMF is funded by the NRC of Canada.

$^2$This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract W-7405-Eng-48 and under Contract DE-AC52-07NA27344. For LBNL this work was supported by the U.S. Department of Energy under Co
9:42AM LE.00007 Precision Test of the Isobaric Multiplet Mass Equation in the A = 32, T = 2 Quintet  R. FERRER, A.A. KWIATKOWSKI, G. BOLLEN, C.M. CAMPBELL, C.M. FOLDEN III, D. LINCOLN, D.J. MORRISSEY, G.K. PANG, A. PRINKE, J. SAVORY, S. SCHWARZ, National Superconducting Cyclotron Laboratory, Michigan State University — Masses of the radionuclides $^{32,34}$Si and $^{34}$P and of the stable nuclide $^{32}$S have been measured with the Low Energy Beam and Ion Trap (LEBIT) Penning trap mass spectrometer. Relative mass uncertainties of 3 x 10^{-8} and better have been achieved. The measured mass value of $^{32}$Si differs from the literature value [1,2] by four standard deviations. The precise mass determination of $^{32}$Si and $^{34}$S have been employed to test the isobaric multiplet mass equation for the A = 32, T= 2 isospin quintet. The experimental results indicate a significant deviation from the quadratic form. This work has been supported by Michigan State University, the NSF under contract number PHY-0606007, and the DOE under the contract DE-FG02-00ER41144. References: 1. G. Audi, A.H. Wapstra, and C. Thibault, Nucl. Phys. A729 (2003) 337 2. A. Paul, S. Röttger, A. Zimbal, and U. Keyser, Hyperfine Interact. 132 (2001) 189

9:54AM LE.00008 Next generation λ-hypernuclear spectroscopy via the (e, e$^\prime$K$^+$) reaction at Jefferson Lab

— TOMOFUMI MARUTA, Graduate School of Science, Tohoku University, JLAB E05-115 COLLABORATION — Spectroscopic study via the (e, e$^\prime$K$^+$) reaction is a very important technique to investigate λ-hypernuclear structure; the reaction favorably excites spin-flip states and on light nuclei, compared to the meson-induced reactions, produces much hypernuclei. So far, it is the only technique that allows absolute mass determination with accuracies of a ≈ 100 kev or better. Two previous experiments that we performed, JLab E09-009 and E01-011, established the experimental technique, and the latter obtained hypernuclear mass spectra up to A ≈ 30 with, for reaction spectroscopy, unprecedented energy resolution as good as 400 keV (FWHM). Our next experiment, E05-115, will investigate λ-hypernuclei in wide mass region up to $^{12}$V. A newly constructed electron spectrometer (HES) and splinter magnet will increase the yield by almost one order of magnitude while preserving the achieved energy resolution. Together with the existing Kaon Spectrometer (HKS), they are scheduled for installation in Jefferson Lab’s Hall C in 2009. The planned experimental program will explore λ-hypernuclei beyond the p-shell for the first time in (e, e$^\prime$K$^+$) reaction spectroscopy. This presentation will give a preparation status report and outline of the experimental program and technique of the next experiment.

1Supported by DoE ER41047 & ER41065 and MEXT, Japan.

Sunday, October 26, 2008 8:30AM - 10:18AM –
Session LF Nuclear Structure: Medium Mass A=100-150

8:30AM LF.00001 Investigation into the Low-Energy Structure of Ru Isotopes via G-Factor Measurements

M.J. TAYLOR, M.A. BENTLEY, University of York, L. BENCZER-KOLLER, G. KUMBARTZKI, G. GURDAL, Rutgers University, V. WERNER, J. QIAN, R. WINKLER, A. HEINZ, E. WILLIAMS, E.A. MCCUTCHEAN, R. CASPERSON, Yale University, A.E. STUCHBERY, Australian National University, B. SHORAKA, University of Surrey, Z. BERANT, Nuclear Research Centre Negev, R. LUTTKE, TU Darmstadt — An experiment was performed to investigate the low-energy structure of the even-A $^{96-104}$Ru isotopes. The experiment utilised the transient field technique combined with Coulomb excitation in inverse kinematics to measure the g factors of the first excited $2^+_1$ states. The transient field was calibrated through measurements of the known g($2^+_1$) in $^{102}$Ru and $^{98}$Mo. The experiment constituted the first ever measurement of the g($2^+_1$) for $^{96}$Ru as well more accurate relative measurements of the g($2^+_1$) for $^{98,100,104}$Ru. Preliminary analysis of the data taken for $^{96}$Ru indicates a value for the g($2^+_1$) close to the collective limit Z/Asuggesting that the two neutrons and six proton holes outside of the N = Z=50 closed shells contribute equally to the $2^+_1$ state wave function. The technique used, results and theoretical interpretations will be presented.

8:42AM LF.00002 Observation of an excited state in $^{101}$Sn via the α-decay of $^{105}$Te

SEAN LIDDIK, IAIN DARBY, University of Tennessee, ROBERT GRZYWACZ, University of Tennessee and Physics Division Oak Ridge National Laboratory, KRZYSZTOF RYKACZEWSKI, Physics Division Oak Ridge National Laboratory, ROBERT PAGE, University of Liverpool, CARL GROSS, Physics Division Oak Ridge National Laboratory, JON BATCHELDER, UNIRIB — The doubly magic nucleus $^{100}$Sn is a key test nucleus for the nuclear shell model. Required information in this region is knowledge of single-particle energies, particularly the energy separation between the $\nu d_{5/2}$ and $\nu g_{7/2}$ orbitals. For the $^{100}$Sn region, the energy separation can be best extracted from the energy of the first excited state in $^{101}$Sn. In experiments performed at the HRIBF using the RMS α-decay chains of $^{109}$Xe → $^{105}$Te → $^{101}$Sn were observed following implants of $^{109}$Xe ions into a DSSD, fully instrumented with Digital Signal Processing, placed within the γ-array CARDS. Double α-decay pulse shapes provide unique and clean coincidence requirement which resulted in the observation of a γ-ray, interpreted as being emitted from the first excited state in $^{101}$Sn. These results will be presented and the implications for the single-particle level assignments will be discussed.

1DOE Grants DE-AC05-00OR22725 (ORNL), DEFG02- 96ER40983 (UT), DEFC03- 03NA00143(NNSA) and by the U.K. STFC

8:54AM LF.00003 Nuclear structure of $^{116}$Cd from the (n, n' γ) reaction  C.S. SUMITHRARACHCHI, P.E. GARRETT, K.L. GREEN, Department of Physics, University of Guelph, Guelph, Ontario, Canada, M. KADI, Department of Chemistry, University of Kentucky, Lexington, Kentucky, USA, N. WARR, Department of Chemistry, University of Kentucky, Lexington, Kentucky, USA & Institute of Nuclear Physics, University of Cologne, Cologne, Germany, J. JOLIE, Institute of Nuclear Physics, University of Cologne, Cologne, Germany, S.W. YATES, Department of Chemistry, University of Kentucky, Lexington, Kentucky, USA — The nuclear structure of the Cd isotopes have been extensively studied with the aim of understanding the role of configuration mixing between multiphonon vibrational and intruder states. The study of the low-lying levels in $^{116}$Cd is particularly important as it has been reported to possess a more complex nuclear structure than is predicted by the interacting boson model(IBM)[1]. The properties of multiphonon vibrational and intruder states in $^{116}$Cd have been investigated with the (n, n'γ) reaction. The measured γ-ray excitation functions, γ-γ coincidences and angular distributions were utilized to derive the level structure of $^{116}$Cd. The electromagnetic properties of levels in $^{116}$Cd and comparisons with IBM-2 calculations will be presented.

9:06AM LF.00004 Precise Lifetime Measurement of $2^+_1$ State in $^{120}$Te by Recoil Distance Doppler Shift Method, J.R. TERRY, V. WERNER, WNSL - Yale, Z. BERRANT, Nuclear Research Center Negev, Beer-Sheva Israel, R.J. CASTERSON, A. HEINZ, WNSL - Yale, G. HENNING, Dept. of Physics, ENS de Chachan, Chachan France, R. LUTTKE, Technische Universitat Darmstadt, Germany, E.A. MCCUTCHEAN, J. QIAN, WNSL - Yale, B. SHORAKA, Dept. of Physics, University of Surrey, UK, E. WILLIAMS, R. WINKLER, WNSL - Yale

The lifetime of the first $2^+_1$ state of $^{120}$Te has been measured using a combination of in-vitro kinematic Doppler shift and nearby background-free gamma-ray spectra. The $2^+_2$ and $4^+_1$ excited states were also observed, providing a measure of the transition strengths to these states relative to the $2^+_1$ state. Results are compared to calculations with and without $2p-2h$ proton intruder configurations across the $Z=50$ shell gap. This work is supported by the U.S. DOE under contract No. DE-FG02-91ER-40609.

9:18AM LF.00005 Spectroscopy of exotic $^{132,135}$Ag produced in fragmentation reactions$^1$, IRINA STEFANESCU, W.B. WALTERS, N. HOTELING, University of Maryland, P.F. MANTICA, J. PEREIRA, J.S. STOKER, B. TOMLIN, NSCL, MSU

We extended the experimental knowledge in the mass region around $^{132}$Sn by identifying the decay of high-spin isomers in the exotic odd-mass $^{132,135}$Ag. The two isotopes were produced at the NSCL laboratory by projectile fragmentation of $^{208}$Pb directed onto a thick Be target. The NSCL Beta Counting System was used to identify the secondary beam fragments. Prompt and delayed gamma-rays following the deexcitation of the fragments were detected with the SEGA array. Partial level schemes for $^{132}$Sn and $^{135}$Sn are proposed for the first time and compared with the results of shell-model calculations.

9:30AM LF.00006 High-spin states in $^{135}$Cs, N. FOTIADES, LANL, J.A. CIZEWSKI, Rutgers Univ., R. KRUCKEN, T.U. Munchen, R.M. CLARK, P. FALLON, I.Y. LEE, A.O. MACCHIPELLI, LBNL, J.A. BECKER, W. YOUNES, LLNL — High-spin states in $^{135}$Cs have been studied following the fission of the $^{226}$Th compound nucleus formed in a fusion-evaporation reaction ($^{190}$Os at 91 MeV on $^{208}$Pb). The Gammasphere array was used to detect $\gamma$-ray coincidences. A sequence of transitions was observed in coincidence with the previously known $786.8$-keV level of $^{135}$Cs at $2^1/2$ and $3.3$ MeV excitation energy. The assignment of this sequence to $^{135}$Cs is supported by coincidences with known transitions in the complementary fragments. The observed experimental states are compared with states in the neighboring $^{137}$Cs nucleus, as well as with states in the $Z=54$ core of $^{134}$Xe. The coupling of the odd proton occupying the $7/2^+$ orbital to the yrast states in $^{134}$Xe can account for the first excited states of $^{135}$Cs. This work was supported by the U.S. Department of Energy under Contracts No. DE-AC52-06NA25396 (LANL), DE-AC52-07NA27344 (LLNL) and AC03-76SF00098 (LBNL) and by the National Science Foundation (Rutgers).

9:42AM LF.00007 Study of low-lying excited states in $^{139}$La via the $(n,n'\gamma)$ reaction$^1$, S.F. ASHLEY, J.N. ORCE, B. CRIDER, E. ELHAMI, M.T. MCCLELLISTREM, S. MUKHOPADHYAY, Dept. of Physics and Astronomy, University of Kentucky, Lexington KY 40506-0055, E. PETERS, Dept. of Chemistry, University of Kentucky, S.W. YATES, Dept. of Physics and Astronomy and Dept. of Chemisty, University of Kentucky — An observable result of Pauli-blocking in atomic nuclei [1] is a reduction in the transition rates between equivalent phonon excitations in odd-A nuclei and even-even nuclei. In particular, studies of low-lying $J^T=1^+$ states in $^{131}$Pr [2,3], imply that the $B(E1:1^+\rightarrow 0^+_1)$ value associated with decays from states with $[2^+\otimes 3^-\otimes \pi^+_{1-}]$-configurations are $\sim 52$–$83\%$ of the $B(E1:1^+_1\rightarrow 0^+_1)$ value associated with decay from the $[2^+\otimes 3^-\otimes \pi^+_{1-}]$-state in $^{140}$Ce. This presentation will focus on lifetimes deduced from an angular-distribution measurement of $^{139}$La, via the $(n,n'\gamma)$ reaction with $E_n=2.0$ MeV, and a comparative interpretation of Pauli-blocking in $^{139}$La and $^{141}$Pr will be drawn.

1Supported by NSF PHY-06-06007 and PHY-02-44453 and DOE AC-02-06CH11357 and DE-FG02-94-ER80348.

9:54AM LF.00008 g-factor measurements in $^{134}$Te and $^{140,142}$Xe, CHRIS GOODIN, K. LI, A.V. DANIEL, N.J. STONE, A.V. RAMAYYA, J.H. HAMILTON, SH. LIU, J. STONE, Vanderbilt University — By using new techniques developed for measuring angular correlations with Gammasphere, the g-factor of the $4^+_1$ state in $^{134}$Te has been measured for the first time. The g-factor measurement is compared to shell model predictions and good agreement is found between experiment and theory. The g-factors of $2^+$ states in $^{140,142}$Xe are also measured for the first time with this method. g-factors in $^{140}$Ba and $^{146,148}$Ce are measured to establish the method by comparison with previous values. The results are discussed in terms of IBM-2 and rotation-vibration models.

10:06AM LF.00009 Octupole correlations in light neutron-rich $^{143,145}$La$^1$, Y.X. LUO$^2$, J.H. HAMILTON, Vanderbilt University, J.O. RASMUSSEN, Lawrence Berkeley National Lab, A.V. RAMAYYA, Vanderbilt University, S.J. ZHU, Tsinghua University, Beijing, China, J.K. HWANG, Vanderbilt University — Intensive investigations have shown strong evidence of octupole deformations and/or correlations in $^{142–144}$Ba, $^{144,146}$Cs and $^{145,147}$La. In the present work the high-spin level scheme of light neutron-rich $^{143}$La is expanded and that of $^{144}$La is proposed for the first time by measuring prompt gamma rays from the spontaneous fission of $^{252}$Cf at Gammasphere. $B(E1)/B(E2)$ ratios, energy displacement $\delta E(I)$ and the rotational frequency ratios $\omega^2(I)/\omega^1(I)$ of the new parity-doublets of $^{143,145}$La indicate that octupole correlations also develop in these light neutron-rich La isotopes. Based on CSM calculations the band-crossings observed in a rotational frequency range of 0.31 to 0.34 MeV for the two even-parity bands in $^{143}$La are interpreted as due to alignment of a pair of $i_{13/2}$ neutrons in the nucleus.

$^1$U.S. DOE and National Natural Science Foundation of China

$^2$also LBNL

Sunday, October 26, 2008 8:30AM - 10:18AM – Session LG Cosmology Jewett Ballroom C
8:30AM LG.00001 Limits on cold dark matter axions from ADMX

GRAY RYBK, University of Washington, STEVEN ASZTALOS, Lawrence Livermore National Laboratory, RICHARD BRADLEY, National Radio Astronomical Observatory, GIANPAOLO CAROSI, Lawrence Livermore National Laboratory, MICHAEL HOTZ, University of Washington, JUNGSEEK HWANG, University of Florida, DARIN KINNION, Lawrence Livermore National Laboratory, LESLIE ROSENBERG, University of Washington, PIERRE SIKIVIE, DAVID TANNER, University of Florida, KARL VAN BIBBER, Lawrence Livermore National Laboratory — The axion, a hypothetical particle invented to solve the strong CP problem in the Standard Model, has properties that also make it a compelling dark matter candidate. The Axion Dark Matter experiment (ADMX) looks for the conversion of nearby halo axions into nearly monochromatic microwave photons. Some theories of axion production of the early universe predict that present day axions will have velocity dispersions much smaller than they would have been produced in thermal equilibrium. The high resolution channel in ADMX takes advantage of these low velocity dispersions to probe even pessimistic axion-to-photon couplings for these “cold axion” models. Additionally, the high resolution channel is sensitive to seasonal and annual changes in a cold axion signal, offering an insight into galactic dark matter distribution. This talk will cover the search for cold dark matter axions with masses of a few MeV using the ADMX high-resolution channel.

8:42AM LG.00002 Limits on thermally-distributed halo dark-matter axions from ADMX

GIANPAOLO CAROSI, Lawrence Livermore National Laboratory, STÉVEN ASZTALOS, Lawrence Livermore National Laboratory, 7000 East Avenue, Livermore, CA 94550, USA, RICHARD BRADLEY, National Radio Astronomical Observatory, MICHAEL HOTZ, University of Washington, JUNGSEEK HWANG, University of Florida, DARIN KINNION, Lawrence Livermore National Laboratory, LESLIE ROSENBERG, GRAY RYBK, University of Washington, PIERRE SIKIVIE, DAVID TANNER, University of Florida, KARL VAN BIBBER, Lawrence Livermore National Laboratory — The Axion Dark Matter eXperiment (ADMX) at LLNL searches for dark-matter axions through their Primakoff conversion to microwave photons, resonantly enhanced in a high-Q cavity permeated by a strong magnetic field. The most general assumption is that halo axions are thermalized with the local virial velocity of the Milky Way, about 270 km/sec, which implies a spectral line-broadening of one part in a million. ADMX has set limits on halo axions for realistic models over an octave of mass range in the few microelectronvolt range. The experiment is the most sensitive spectral receiver in the world, able to detect signals in the GHz range well below a yoctowatt. This talk will outline the experimental technique, data analysis and results for the medium-resolution search.

8:54AM LG.00003 Overview, Technical Description and Future of the Axion Dark Matter eXperiment

1, S. ASZTALOS, LLNL, R. BRADLEY, Natl. Radio Astronomical Observatory, G. CAROSI, LLNL, M. HOTZ, Univ. of Washington, J. HWANG, Univ. of Florida, D. KINNION, LLNL, L. ROSENBERG, G. RYBK, Univ. of Washington, P. SIKIVIE, D. TANNER, Univ. of Florida, K. VAN BIBBER, LLNL, ADMX COLLABORATION — The Axion Dark Matter eXperiment (ADMX) at LLNL searches for dark-matter axions through their Primakoff conversion to microwave photons, resonantly enhanced in a high-Q cavity permeated by a strong magnetic field. The original operations of the experiment employed conventional microwave amplifiers, using heterojunction field-effect transistor amplifiers (HFET) amplifiers; these devices had a system noise temperature around 3 K, determined by the sum of the 1.5 K physical temperature and the 1.5 K amplifier equivalent noise temperature. ADMX is the world’s quietest spectral receiver in the GHz regime, capable of detecting a single RF photon per minute above the cavity blackbody and amplifier noise. ADMX has covered a frequency range of 460 to 812 MHz (1.9 - 3.4 micro-eV) over that octave of mass range axions were excluded as the Milky Way halo dark matter for well-motivated models of the coupling of the axion to two photons. An upgrade of ADMX has recently been completed, which replaced the previous HFET amplifiers with SQUID amplifiers. This talk will describe the experiment, both hardware and data analysis, the SQUID amplifier technology and recent operating experience, and discuss plans for a second-phase upgrade to further reduce the systems noise temperature to ~100 mK.

9:06AM LG.00004 Measuring the radiative width of the Hoyle state

JASON BURKE, LLNL, STARS/LIBERACE COLLABORATION — A key rate that governs energy generation in stars is the triple alpha rate. The ratio of the radiative width to the total width of the Hoyle state represents the probability that a 12C nucleus will be formed when three alpha particles fuse together in a stellar environment. Measurements of the ratio of the radiative width to total width using an alpha particle scattering technique developed in the 1960’s have been made several times. Using this technique the Hoyle state is excited via inelastic nuclear scattering and the scattered alpha particles and recoiling 12C nuclei are detected in coincidence. We have improved on this technique by using a large area highly segmented silicon detector array called STARS. During a five day run we accumulated 1500 alpha–12C recoil coincident events over an angle range from 40 to 55 degrees in 1 degree steps. The experimental results including statistical and systematic uncertainty analysis will be presented. This work was performed under the auspices of the U.S. Department of Energy under contract numbers DE-AC52-07NA27344 (LLNL), DE-AC02-05CH11231 (LLNL) and DE-FG52-06NA26206 (UR).

9:18AM LG.00005 Astrophysical Data Transmission in Planck Units

SHANTILAL GORADIA, Gravity Research Institute, Inc. — “Data Communication and Net Working” by Forouzan expresses (an informatics equivalent of statistics) that N (data rate or bits/second) divided by T (number of data elements per signal or log2 L) is the baud rate. For N = 10^43 Planck times per second, and L = 10^30, the number of photons in the universe, the baud rate is more than 10^30, so high a signal rate for the carriers of the attractive and repulsive pulses that we, the observers, would think that gravity is continuous, and not probabilistic. Any potential slight correction to the above as it may apply to the case, or its application to smaller baryon number separations in integer number of Planck lengths, are mutually supplementary and complimentary, portraying two ducks that, not only walk like ducks, but also slight modification to the inverse square law, in [1] that the probability of an interaction between two particles is inversely proportional to the square of their distances.

9:30AM LG.00006 The mass, energy, space and time system theory-MEST

DAYONG CAO, Beijing Natural Providence Science & Technology Development CO., LTD — Things have their own system of mass, energy, space and time of themself. (The MEST for short thereinafter). Mass is density, energy is force, time is frequency, spac is amplitude square. There are the transmutation between space-time and mass-energy. New mass-energy wave equation, space-time particle equation are being put forward. With anode dark current of hole and mass wave, give a new explanation to the photoelectric effect experiment; and get new mass-energy equation which equal the mass-energy relation of Einstein and Electrodynamic. And the new photoelectric conversion equation are being put forward. Consequently, it is discovered the transmutation between space-time and mass-energy. New atom and nuclear model And New speed of light theory are being put forward. There are different mass of electrons of atom. And explain the probability of wave. Deduc the new uncertainty principle, uncertainty and probability can not be divided. MEST can unites both orbit equations of nine planes and orbit equations of electrons of H and He. MEST can unites both wave equations of nine planes and particle equations of sun. We can change the orbit of asteroid who will impacted near our earth.

9:42AM LG.00007 Astrophysical Data Transmission in Planck Units

SHANTILAL GORADIA, Gravity Research Institute, Inc. — “Data Communication and Net Working” by Forouzan expresses (an informatics equivalent of statistics) that N (data rate or bits/second) divided by T (number of data elements per signal or log2 L) is the baud rate. For N = 10^43 Planck times per second, and L = 10^30, the number of photons in the universe, the baud rate is more than 10^30, so high a signal rate for the carriers of the attractive and repulsive pulses that we, the observers, would think that gravity is continuous, and not probabilistic. Any potential slight correction to the above as it may apply to the case, or its application to smaller baryon number separations in integer number of Planck lengths, are mutually supplementary and complimentary, portraying two ducks that, not only walk like ducks, but also slight modification to the inverse square law, in [1] that the probability of an interaction between two particles is inversely proportional to the square of their separations in integer number of Planck lengths, are mutually supplementary and complimentary, portraying two ducks that, not only walk like ducks, but also talk like ducks. Therefore, they are ducks. Refer to: [1] Goradia, Shantilal http://www.arXiv.org/df/physics/0210040v4.
9:42AM LG.00007 Deeper Probing of the Fine-structure Constant , SHANTILAL GORADIA, Gravity Research Institute, Inc. — In our earlier attempt in [1] to derive fine-structure constant, one subtle reason why the natural logarithm of the age of the universe in Planck times comes out to be slightly greater than the reciprocal of the fine structure constant is that the variable $W$ in Boltzmann’s expression should be the age of the universe in Planck times divided by the bit depth for our specific application. Since we cannot decode the nature’s bit depth, we cannot come up with the expected value of ALPFA. For an assumed bit depth of 10, the reciprocal of ALPFA goes down by In10 (2.3) without having a significant impact on the order of magnitude of the baud rate (baud rate = bits per second/bit depth = $10^{10}$ (Planck time/second)/10 = $10^{9}$). Use of terms and equations from informatics in both of author’s interrelated abstracts this meeting is meant to engage a wider audience simply. [1] Goradia, Shantilal “What is Fine-structure Constant?” http://www.arXiv.org/pdf/physics/0210040v3.

9:54AM LG.00008 The mass, energy, space and time system of Wave, Particle and universe -MEST , DAYONG CAO, Beijing Natural Providence Science & Technology Development CO., LTD — Things have their own system of mass, energy, space and time of themself. (The MEST for short thereinafter). Mass is density, energy is force, time is frequency, spac is amplitude square. New mass-energy wave equation, space-time particle equation are being put forward. Mass, Energy, Space (Radius), Time (Period) of nine planes compose a MEST of plane; Mass(Density of sun), Energy (Gravity of sun), Space (Radius of nine planes), Time (Period of nine planes) compose other MEST of sun. MEST can unites both wave equations of nine planes and particle equations of sun. Mass, Energy, Space (Radius), Time (Period) of electron of H compose a MEST of electron; Mass, Energy (coulombic force), Space (Position of electron), Time (Period of electron) compose other MEST of nucleon of H. MEST can unites both wave equations of electron of H and particle equations of nucleon of H. MEST can unites both wave equations of electron of H and wave equations of nine planes. Dark matter-energy is from Black hole. Because Black hole have a applied thrust to it, So its quantity that be estimated is bigger than it’s in fact. There are a lot of astroides and dark matter-energy near the orbit of Jupiter. They will impacted near our earth, when Dark matter-energy changes the orbit of these asteroids. It is a recurrent action. Because there is a interaction between back hole and the solar system.

10:06AM LG.00009 The mass, energy, space and time system of Star and Black hole -MEST , DAVAO CAO, Beijing Natural Providence Science & Technology Development CO., LTD — Things have their own system of mass, energy, space and time of themself. (The MEST for short thereinafter). Mass is density, energy is force, time is frequency, spac is amplitude square. In MEST of Star, Mass-energy condense to center, Space-time radiate to Around. An Nuclear is like the Mass-energy center while the charge cloud is like the Space-Time around. Neutron, Proton, Electron; Muon atom compose a MEST-1 of Star. Neutron, Proton, Pion meson+, Pion meson- compose a MEST-2 of Star. Electron, Muon atom, Elenuetrum, Muoneutron compose a MEST-3 of Star. Pion meson+, Pion meson-, Elenuetrum, Muoneutron compose a MEST-4 of Star. In MEST of Black hole, Space-time condense to center, Mass-energy radiate to Around. Black hole is space-time particle center while the dark matter-energy is the radiate mass-energy Wave around Black hole. The dark matter-energy is from the Black hole. MEST of the dark matter-energy reverse of MEST-1, MEST-2, MEST-3, MEST-4. Because Black hole have a applied thrust to dark matter-energy, So the quantity of mass-dark matter-energy that be estimated is bigger than it’s in fact. Black hole and Dark matter-energy can reduce the frequency of the light of star.

Sunday, October 26, 2008 8:30AM - 10:06AM
Session LH Instrumentation I Jewett Ballroom F

8:30AM LH.00001 Status of the HELIOS Spectrometer at ATLAS , ALAN WUOSMAA, Western Michigan University, Argonne National Laboratory, Manchester University, HELIOS COLLABORATION — The HELIOS device is a new spectrometer under construction at the ATLAS facility at Argonne National Laboratory designed to study transfer and inelastic scattering reactions in inverse kinematics, particularly with radioactive beams. The device consists of a large-bore, 3T superconducting solenoid with the magnetic axis aligned with the beam. Particles are transported along helical orbits from a target in the center of the solenoid to an array of position-sensitive silicon detectors placed along the solenoid axis. The construction of the spectrometer is well underway, including a new beam line, the components necessary to transform the magnet volume to a vacuum chamber, the detector arrays and moveable target mechanisms, all of which must function in a high magnetic field. The status of the construction and testing of the device will be presented. Work supported by the U. S. Department of Energy, Office of Nuclear Physics under grant numbers DE-FG02-04ER41320 and DE-AC02-06CH11357.

8:42AM LH.00002 Determination of neutron beam parameters of the DANCE flight path at LANCSE , JOHN ULLMANN, MICHAL MCKO, TODD BREDEWEG, AARON COUTURE, ROBERT HIGHT, MARIAN JANDEL, AUGUST KEKSIS, SHANTILAL GORADIA, Gravity Research Institute, Inc. — In our earlier attempt in [1] to derive fine-structure constant, one subtle reason why the natural logarithm of the age of the universe in Planck times comes out to be slightly greater than the reciprocal of the fine structure constant is that the variable $W$ in Boltzmann’s expression should be the age of the universe in Planck times divided by the bit depth for our specific application. Since we cannot decode the nature’s bit depth, we cannot come up with the expected value of ALPFA. For an assumed bit depth of 10, the reciprocal of ALPFA goes down by In10 (2.3) without having a significant impact on the order of magnitude of the baud rate (baud rate = bits per second/bit depth = $10^{10}$ (Planck time/second)/10 = $10^{9}$). Use of terms and equations from informatics in both of author’s interrelated abstracts this meeting is meant to engage a wider audience simply. [1] Goradia, Shantilal “What is Fine-structure Constant?” http://www.arXiv.org/pdf/physics/0210040v3.

8:54AM LH.00003 Calibration of a superconducting beta spectrometer using 66Ga , GREGORY SEVERIN, LYNN KNUTSON, University of Wisconsin-Madison, ELIZABETH GEORGE, PAUL VOYTAS, Wittenberg University, SEAN COTTER, University of Wisconsin-Madison — We have constructed a new superconducting Wm spectrometer with roughly 1sr. acceptance and 2% FWHM momentum resolution. Use of terms and equations from informatics in both of author’s interrelated abstracts this meeting is meant to engage a wider audience simply. [1] Goradia, Shantilal “What is Fine-structure Constant?” http://www.arXiv.org/pdf/physics/0210040v3.

9:06AM LH.00004 Cyclotron gas stopper: simulations and predicted performance , C.M. CAMPBELL, S. CHOUGHAN, C. GUENAUT, D. LAWTON, F. MARTI, J. OTTARSON, S. SCHWARZ, A.F. ZELLER, P. ZAVODSZKY, National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, MI, USA, G. BOLLEN, National Superconducting Cyclotron Laboratory and Department of Physics and Astronomy, Michigan State University, East Lansing, MI, USA, D.J. MORRISSEY, G. PANG, National Superconducting Cyclotron Laboratory and Department of Chemistry, Michigan State University, East Lansing, MI, USA — Projectile fragmentation followed by in-flight separation provides fast, chemistry-independent access to a wide range of $^{3}$-unstable nuclides. To optimize their use, these exotic beams should be available at energies from rest to several MeV/u. This can be achieved by stopping fast beams in a volume of helium, extracting the stopped ions, and reaccelerating them to the desired energy. A “cyclotron gas stopper” has been proposed to overcome the limitations of current and proposed linear gas stoppers. The current design of the NSCL cyclotron-stopper uses a 2 meter diameter superconducting spiral-sector magnet with ion-guiding carpets in the central region. Complete simulations have been performed starting with realistic beam properties for 17 projectile fragments ranging from $^{6}$Li to $^{17}$O. Details of the NSCL cyclotron-stopper and the simulation package developed to predict its performance will be presented.

1 NSF Grant - PHY055649
9:18AM LH.00005 Compact High Resolution Isobar Separator for Decay Spectroscopy. A. PIECHACZEK, Louisiana State University, V. SCHHEPUNOV, H.K. CARTER, J.C. BATCHELDER, UNIRIB, Oak Ridge Associated Universities, E.F. ZGANJAR, Louisiana State University, S.N. LIDDLE, University of Tennessee, H. WOLLNIK, IONTECH, B.O. GRIFFITH, Oak Ridge Associated Universities — A compact isobar separator and separator, based on the Multi-Pass-Time-of-Flight (MTOF) principle, is being developed by the University Radioactive Ion Beam (UNIRIB) Consortium. Using $N_2$ as sample gas, a mass resolving power of 113,000 (FWHM) and a transmission of $\sim 50 \%$ have been achieved after a time-of-flight of 9.7 ms. Coupled to the UNIRIB mass separator at HRIBF, MTOF will provide isotopically pure samples of species around $^{199}$Sn, of neutron deficient rare earth nuclei and of neutron rich nuclei for use in decay studies and mass measurements. With beam cooling and bunching, we expect a mass resolving power (FWHM) of $\sim 400,000$, transmission of $\sim 25 \%$ and isotopic suppression of adjacent elements $\sim 40,000$. As a by product, MTOF will determine the masses of nuclei investigated with accuracies of $10^{-6}$, or about 100 keV for a mass $A = 100$ nucleus. Spectra demonstrating the separation of stable nuclides using a Bradbury-Nielsen gate will be shown.

9:30AM LH.00006 Radioactive Ion Beam Purification by Selective Adsorption. C. JOST, H.K. CARTER, B.O. GRIFFITH, C.A. REED, Oak Ridge Associated Universities, K.-L. KRATZ, Max Planck Institute for Chemistry, Mainz, T. STORA, ISOLDE-ERN, D.W. STRACENER, Oak Ridge National Laboratory — Isobaric contaminations in ISOL beams are a recurrent problem in nuclear physics experiments. Surface effects in the transfer line between target and ion source can be employed to achieve additional selectivity. Since interactions of the atoms’ outer electrons with the surface determine adsorption behavior it can change drastically within an isobaric chain, introducing a chemical selectivity. Quartz transfer lines are currently applied at ISOLDE to reduce alkali contaminations [1]. We will conduct an on-line study of the adsorption behavior of fission products on a range of materials stable at high temperatures. Therefore a special target–ion source unit with a variable-temperature transfer line and interchangeable liner has been constructed in collaboration with the ISOLDE technical group. Results of first tests using new adsorption materials at the on-line separator test facility at Holifield Radioactive Ion Beam Facility, ORNL, will be presented. [1] Bouquerel et al., Europ. Phys. J. — Spec. Top. 150, 277 (2006)

1Work supported in part by the U.S. Department of Energy.

9:42AM LH.00007 Separation of $H_2$, HD and $D_2$ using Low Temperature Gas Chromatography. C. STEVEN WHISNANT, TRAVIS KELLEY, RYAN BURKÉ, PATRICK HANSÉN, James Madison University — The frozen spin HD target developed for the study of photonuclear physics by the LEGS collaboration at Brookhaven National Laboratory (and now moved to JLab) requires high purity HD gas to produce targets with spin relaxation times on the order of months. Since this purity is not available commercially, the gas is distilled at low temperature to reduce the residual $H_2$ and $D_2$ contamination. Quantifying the remaining amount of these contaminants is important for preparing a target that obtains the desired polarization and spin relaxation time. To measure the relative concentrations of $H_2$ and $D_2$, a gas chromatography system has been developed that separates the isotopes of hydrogen. The system uses a 50 meter porous-layer open-tabular (PLOT) 5 Å carbon molsieve column with an inner diameter of 0.53 mm held at temperatures near 150K. The carrier gas is neon. The signal is produced by measuring differences in thermal conductivity between hydrogen and neon. Under these conditions, not only are $H_2$ and $D_2$ separated from HD, but $o$-$H_2$ and $p$-$H_2$ are also well separated from one another. The resulting chromatograms are fit to extract areas and corrected for isotopic differences in thermal conductivity to produce relative concentrations. The analysis of several gas samples will be presented and the status of the method discussed.

2This work is supported, in part, by the NSF.

9:54AM LH.00008 ABSTRACT WITHDRAWN

Sunday, October 26, 2008 10:30AM - 12:18PM — Session MA Frontiers in Nuclear Theory — Simmons Ballroom 2-3

10:30AM MA.00001 QCD energy-momentum tensor correlators and viscosity. HARVEY MEYER, Massachusetts Institute of Technology — An accurate lattice determination of the energy-momentum tensor two-point function is now possible in the pure gauge theory due to an efficient algorithm and powerful computing resources. At finite temperature, the temporal correlators are related by Kubo formulas to transport properties of the quark-gluon plasma, namely shear and bulk viscosity. The latter play a central role in interpreting data from heavy ion collisions at RHIC and LHC. The Euclidean correlators can also be confronted with two opposite pictures of the plasma formed at these colliders: the weakly coupled asymptotic-temperature regime, and the strongly coupled regime studied in supersymmetric gauge theories by AdS/CFT methods. Finally, I will discuss the prospects of calculating the correlators in full QCD.

10:06AM MA.00002 The Baryon Resonance Spectrum and the $1/N_c$ Expansion. RICHARD LEBED, Arizona State University — Why do baryon resonance multiplets exist, and what controls their formation and decays? It is natural to consider them as merely excited states of some three-quark or meson-nucleon potential. But these are just simplistic quantum-mechanical pictures that recognize neither the full field-theoretical complexities of QCD nor the extremely brief lifetimes of resonances due to quark pair production. Both of these issues are addressed by the $1/N_c$ expansion of QCD, where $N_c$ is the number of color charges. Constraints arising at large $N_c$ on meson-baryon scattering amplitudes not only create linear relationships between them, thus linking distinct partial waves and their embedded resonances, but also restrict the possible resonant decay channels. I present strong experimental evidence in favor of this approach, describe the multiplet structure that it predicts, and show how to perform the analysis beyond the strict large $N_c$ limit by incorporating $1/N_c$-suppressed effects.

1Supported by the NSF under Grant Nos. PHY-0456520 and PHY-0757394.

11:42AM MA.00003 Universality in Nuclear Physics and Leading Corrections. LUCAS PLATTER, Ohio State University — Effective field theories (EFT) are the ideal tool to calculate observables of systems with a separation of two scales. The ratio of these scales can be used as a small expansion parameter and observables can therefore be calculated in a controlled expansion which allows reliable error estimates. One such separation is scales familiar in nuclear physics is the sizable difference between the nucleon-nucleon scattering length and the associated interaction range $r^* \sim 1/m_n$. In the last decade an EFT has been developed which allows for a precise calculation of observables of low-energy nuclear systems. This EFT is built from contact interactions only and is the appropriate framework for systems with relative momenta $k \ll 1/|r|$. Systems with a large scattering length have recently also gained a lot of interest in atomic physics. The possibility to change the two-body scattering length if a Feshbach resonance can be exploited gives the opportunity to analyze many- and few-body systems with a tunable interaction strength. In my talk I will present recent results obtained with this EFT. In particular, I will discuss universal relations for spin-1/2 fermions which can be derived using the well-known operator product expansion and which apply to neutron matter at very low densities. I will then consider the three-nucleon case and discuss how observables can be calculated to higher order in the EFT expansion and how these finite range effects impact the universal limit of this EFT. If time allows I will present results for electromagnetic observables calculated within this framework.
10:42AM MC.00002 A Low-Temperature Energy Calibration System for the CUORE Bolo-
metric Double Beta-Decay Experiment . KARSTEN HEEGER, University of Wisconsin, CUORE COLLABORATION — CUORE, the
Cryogenic Underground Observatory for Rare Events, is a next-generation experiment to search for neutrinoless double-beta decay in $^{130}$Te. Using an array of 988 $^{130}$TeO$_2$ crystals at 10 mK with a total mass of $130$ Te of 204 kg, CUORE will search for an excess of events above background near the Q-value of 2530 keV and probe the effective neutrino mass with a sensitivity of a few tens of meV. A precise measurement of the event energy with the bolometer array is crucial for the identification of candidate double beta-decay events. A novel, low-temperature calibration system with ultra-low background is being developed to perform a precise calibration of the energy response of each of the 988 $^{130}$TeO$_2$ crystals in the CUORE bolometer array. We present the design, expected performance, and experimental challenges of this low-temperature calibration system.

10:42AM MC.00002 A Low-Temperature Energy Calibration System for the CUORE Bolo-
metric Double Beta-Decay Experiment . KARSTEN HEEGER, University of Wisconsin, CUORE COLLABORATION — CUORE, the
Cryogenic Underground Observatory for Rare Events, is a next-generation experiment to search for neutrinoless double-beta decay in $^{130}$Te. Using an array of 988 $^{130}$TeO$_2$ crystals at 10 mK with a total mass of $130$ Te of 204 kg, CUORE will search for an excess of events above background near the Q-value of 2530 keV and probe the effective neutrino mass with a sensitivity of a few tens of meV. A precise measurement of the event energy with the bolometer array is crucial for the identification of candidate double beta-decay events. A novel, low-temperature calibration system with ultra-low background is being developed to perform a precise calibration of the energy response of each of the 988 $^{130}$TeO$_2$ crystals in the CUORE bolometer array. We present the design, expected performance, and experimental challenges of this low-temperature calibration system.

10:54AM MC.00003 Barium tagging R&D for the EXO double beta decay experiment . CARTER HALL, University of Maryland, EXO COLLABORATION — The EXO collaboration is developing and executing large scale experiments to search for the neutrinoless double beta decay of Xenon-136. This decay, if observed, would have far reaching implications for neutrino physics, including the identification of the neutrino as a Majorana particle. One attractive feature of Xenon-136 as a double beta decay source is the possibility that the daughter nucleus produced by the decay (Barium-136) could be identified on an event-by-event basis through its unique spectroscopic signature. The technology to observe single barium ions in an ion trap was first developed by atomic physicists in the 1970's and 1980's. We will describe in this talk the current status of our efforts to apply this technique to address one of the most important problems in nuclear and particle physics today.
12:06PM MC.00009 Muon Tracking for Optimized Background Rejection at KamLAND

THOMAS O’DONNELL, UC Berkeley/LBNL, KAMLAND COLLABORATION — KAMLAND has demonstrated convincingly that neutrinos oscillate. The experiment has determined the neutrino oscillation parameter \( \Delta m^2_{31} \) to unprecedented precision, has helped constrain the neutrino mixing angle \( \theta_{13} \) and has explored the potential application of neutrinos as a geophysical probe. The heart of the detector is 1 kton of hydrocarbon based scintillator located underground in Japan. A purification upgrade is currently underway which will enable KAMLAND to execute a low energy solar neutrino program in parallel with the anti-neutrino program. Like many underground experiments, fast neutrons and other spallation products from cosmic ray muons present challenging backgrounds. In many cases these backgrounds can be reduced by rejecting events with the correct spatial and temporal correlation to muons. High muon tracking resolution is desirable to achieve efficient background rejection while maintaining maximal detector exposure. A new auxiliary muon tracking system is being commissioned to optimize the main detector muon reconstruction algorithm and further characterize post muon events at KAMLAND. This system and the impact for CNO/\(^{14}\)C solar neutrino observation will be described.

Sunday, October 26, 2008 10:30AM - 12:18PM –
Session MD Hard Scattering in Relativistic Nuclear Collisions
Jewett Ballroom G-H

10:30AM MD.00001 Systematic Comparison of Jet Energy-Loss Schemes in a 3D hydrodynamic medium

STEFFEN BASS, Duke University, CHARLES GALE, McGill University, ABHIJIT MAJUMDER, Duke University, CHIHO NONAKA, Nagoya University, GUANG-YOU QIN, McGill University, THORSTEN RENK, University of Jyvaskyla, JOERG RUPPERT, McGill University — We perform a systematic comparison of jet energy-loss calculations in the BDMPS/ASW, HT and AMY approaches. Since we use identical medium evolution in all three approaches we are in a unique position to isolate differences among the three calculations solely due to their energy-loss implementation. We find that the parameters of all three calculations can be adjusted to provide a good description of inclusive data on \( R_{AA} \) versus transverse momentum. However, we do observe slight differences in their predictions for the centrality- and azimuthal angular dependence of \( R_{AA} \) vs. \( p_T \). We also note that the value of the transport coefficient \( \hat{q} \) needed in the three approaches to describe the data differs significantly. We shall attempt to shed some light onto this \( \hat{q} \)-puzzle.

10:42AM MD.00002 Jet fragmentation functions for identified particles in \( p+p \) collisions at 200 GeV in the STAR experiment

ELENA BRUNA, Yale University, STAR COLLABORATION — According to theoretical predictions, jet quenching in heavy-ion collisions modifies the jet energy and multiplicity distributions, as well as the jet hadrochemical composition. The measurement of jet fragmentation functions in \( p+p \) collisions at 200 GeV provides a baseline to study jet modifications in \( Au+Au \) collisions at RHIC. A cone algorithm is used to reconstruct jets in the STAR Time Projection Chamber and Electromagnetic Calorimeter; a study of the jet energy resolution based on PYTHIA+GEANT simulations is reported. We present the results on distributions of jet fragments in \( p+p \) collisions at 200 GeV in STAR for charged hadrons and identified particles at different jet energies and cone radii. The results are compared to MLLA (modified leading logarithmic approximation) calculations which provide a good description of the data at higher jet energies.

10:54AM MD.00003 Full jet reconstruction in \( p+p \) collisions at \( \sqrt{s} = 200 \text{ GeV} \) in PHENIX

YUE SHI LAI, Columbia University — Full jet reconstruction in acceptance-limited detectors is challenging and has been rarely attempted. We developed a Gaussian filter based jet reconstruction algorithm that not only reduces the sensitivity to the detector acceptance limit, but also reduces background effects from soft QCD in hadronic collisions and the heavy ion background. The algorithm in Monte-Carlo simulations has been found to be comparable and in some variables better than the conventional cone and \( k_T \) algorithms [1]. We present the first results in applying the Gaussian filter based jet reconstruction in \( p+p \) collisions at \( \sqrt{s} = 200 \text{ GeV} \) using the PHENIX detector, thus demonstrating the applicability of jet reconstruction in an acceptance-limited detector. [1] Y.-S. Lai, B. A. Cole, “Jet reconstruction in hadronic collisions by Gaussian filtering”, arXiv:0806.1499 (2008).

11:06AM MD.00004 Rapidity Densities of Produced Hadrons in \( p+p \) collision

K. HAGEL, Cyclotron Institute, Texas A & M University, BRAHMS COLLABORATION — The characteristics of hadrons produced in \( p+p \) collisions at high energies provide important information on elementary processes. Such data can be, and have been, used to establish an elementary reference for heavy ion collisions at RHIC. The data can also be used to constrain calculations that model elementary processes. For \( p+p \) collisions at \( \sqrt{s} = 62.4 \) and 200 GeV, we present spectra and derived rapidity distributions of identified positive and negative pions, kaons and protons over the rapidity range from 0 to 3.5. The results of these measurements are compared to the results of various model calculations commonly used as a base for Heavy Ion comparisons.

11:18AM MD.00005 Hump-backed distribution without jet reconstruction in direct-\( \gamma \)-hadron correlations

MICHAEL TANNENBAUM, Brookhaven National Laboratory — Borghini and Wiedemann proposed using the hump-backed or \( \xi = \ln(1/z) \) distribution of jet fragments, which is a signature of QCD coherence for small values of particle momentum fraction, \( z = p/p_{\text{jet}} \), to explore the medium-modification of jets in heavy ion collisions. The use of the \( \xi \) variable would emphasize the increase in the emission of fragments at small \( z \) due to the medium induced depletion of the number of fragments at large \( z \). It was presumed that full jet reconstruction would be required. However, one of the original measurements of the \( \xi \) distribution in e+e- collisions on the Z^0 resonance at LEP was made using the inclusive distribution of \( x^0 \), which could be plotted in either the \( z \) or the \( \xi \) variable since the energy of the jets for di-jet events was known. A similar state of affairs exists for direct-\( \gamma \)-hadron correlations in \( p+p \) and \( A+\bar{A} \) collisions since, modulo any \( k_T \) effect, the jet recoiling from a direct-\( \gamma \) has equal and opposite transverse momentum to the precisely measured \( \gamma \). Thus, the \( x_E \) or \( x_T \) distribution of the away-side hadrons from a direct-\( \gamma \) represents the away-jet fragmentation function, as suggested by Wang, Huang and Sarcevic, so that \( dN/dx = z dN/dz \) can be derived. Examples from RHIC measurements will be given and compared to previous results.

1 Supported by U.S. Department of Energy, DE-AC02-98CH10886.

11:30AM MD.00006 Direct photon-hadron correlations measured using the PHENIX detector

MEGAN CONNORS, Stony Brook University, PHENIX COLLABORATION — Two-particle correlations have been used to study the medium created at RHIC. Since photons do not interact with the strongly coupled medium, they should escape with the same momentum that they had when originally produced by the hard scattering. Therefore, by triggering on a high momentum photon and making angular correlations with hadrons in the event, to good approximation, we know the momentum of the jet which produced these associated hadrons. This is important for understanding jet energy loss in the medium. To extract direct photon-hadron correlations from the large meson decay photon background, we use a statistical subtraction method and more recently an isolation-cut method in \( p+p \) which shows a large increase in precision. This talk will present the latest direct photon-hadron correlation results from the \( p+p \) and \( Au+\bar{Au} \) collisions \( \sqrt{s_{NN}} = 200 \text{ GeV} \) measured at PHENIX. We use the data to study modification of the fragmentation function in \( Au+Au \), as compared to \( p+p \) collisions.
11:42AM MD.00007 Study of High pT Muons with IceCube, LISA GERHARDT, Lawrence Berkeley National Laboratory, ICECUBE COLLABORATION — Study of High pT Muons with IceCube Muons with a large transverse momentum (pT) are produced in cosmic ray air showers via semileptonic decays of heavy quarks and the decay of high pT kaons and pions. These high pT muons will have a large lateral separation from the shower core. IceCube, a neutrino telescope consisting of a three-dimensional array of photodetectors buried in the ice of the South Pole and a surface air shower array, is well suited for the detection of high pT muons. The surface shower array can determine the energy, location and direction of the cosmic ray air shower while the IceCube array can do the same for the high pT muon. This makes it possible to measure the average separation as well as the shape of the pT spectrum of these muons which can be used to probe the composition of high energy cosmic rays.

11:54AM LD.00008 Longitudinal scaling of net-protons in Au+Au and pp collisions at RHIC energies, FLEMMING VIDEBAEK, Brookhaven National Lab, BRAHMS COLLABORATION — BRAHMS has studied net-protons distributions in Au+Au and p+p collisions at √sNN=62.4 and 200 GeV. Net-proton distributions reflect the net-baryon yields and can be used to extract the nuclear stopping in the collisions, thus providing information on baryon number transport and energy available for particle production. The talk will present final and preliminary results from the above mentioned studies. It will be shown that in p+p and in Au+Au central collisions that net-proton distributions exhibit longitudinal scaling once the target contribution to the projectile rapidity range is corrected for. The difference between p+p and Au+Au will be discussed. Aspects of future measurements at the LHC of net-baryons at mid-rapidity will be brought forth.

1This work was supported by the Office of Nuclear Physics of the U.S. Department of Energy.

12:06PM MD.00009 Recent Updates of A Multi-Phase Transport (AMPT) Model, ZI-WEI LIN, East Carolina University — We will present recent updates to the AMPT model, a Monte Carlo transport model for high energy heavy ion collisions, since its first public release in 2004 and the corresponding detailed descriptions in Phys. Rev. C 72, 064901 (2005). The updates often result from user requests. Some of these updates expand the physics processes or descriptions in the model, while some updates improve the usability of the model such as providing the initial parton distributions or help avoid crashes on some operating systems. We will also explain how the AMPT model is being maintained and updated.

Sunday, October 26, 2008 10:30AM - 12:06PM – Session ME.0001 Nuclear Structure: Medium Mass A=50-100
Simmons Ballroom 1

10:30AM ME.0001 Neutron Transfer Dynamics and Doorway to Fusion in TDHF Theory, SAIT UMAR, VOLKER OBERACKER, Vanderbilt University — Within the time-dependent Hartree-Fock (TDHF) theory, we analyze in detail the mass exchange in the vicinity of the Coulomb barrier for heavy-ion collisions involving neutron-rich nuclei. Two examples are considered: 160 + 24O and 40Ca + 96Zr. Specifically, we study the neutron densities of the neutron-rich nucleus as a function of time, and we examine the neutron single-particle probabilities long after the recoil. In the 160 + 24O reaction, most of the mass transfer originates from the 2s1/2 neutron state of 24O. In the 40Ca + 96Zr reaction, the 2p1/2 state in 96Zr dominates the mass transfer, in particular the magnetic substates with the most positive quadrupole moments. We find that the potential barriers seen by individual single-particle states can be considerably different than the effective barrier of the ion-ion potential. Hence, we observe a substantial transfer probability even at energies below the effective fusion barrier. Ref: 1. A.S. Umar, V.E. Oberacker, and J.A. Maruhn, Eur. Phys. J A (2008), in print

1Supported by DOE grant DE-FG02-96ER40963.

10:42AM ME.0002 Systematics of Hot Giant Dipole Resonance Parameters, ANDREAS SCHILLER, Ohio University, MICHAEL THOENNESSEN, KATHERINE McCAPLINE, Michigan State University — The dependence of the Giant Dipole Resonance (GDR) width on spin and temperature is a much debated subject in the literature. A universal scaling law has been proposed by Kusnezov et al. [D. Kusnezov et al. Phys. Rev. Lett. 81, 542 (1998)]. Recently, we completed a literature survey of GDR parameters which provided us with a data set about five times as big as the one which was used by Kusnezov et al. [A. Schiller and M. Thoennessen, At. Data Nucl. Data Tables 93, 549 (2007)]. The Kusnezov scaling law is tested over this large data set. The data is also broken down into subsets of data with common characteristics such as deformation. We will discuss the limits of applicability of the Kusnezov scaling law.

2Funding provided by the NSF grants Nos. PHY01-10253 and PHY02-43709 and by DoE grant No. DE-FG02-88ER40387.

10:54AM ME.0003 On Isoscalar magnetic moments of excited states, YITZHAK SHARON, LARRY ZAMICK, SEAN YEAGER, Rutgers University — We first review the isoscalar magnetic moments of odd A mirror pairs of closed major shells plus or minus one nucleon. We note systematic deviations in experiment-Schmidt. For j=1+1/2 the deviation is positive (stretch) but for j=1-1/2 it is negative (jackknife). But the main emphasis is on 2+ states of even-even N=Z nuclei which have isospin T=0 and hence isoscalar moments. This work is stimulated by recent measurements by Speidel’s and Koller’s group on 2+ states 32S, 36Ar and 44Ti and on 4+ in 20Ne. The measured values of g factors for all these nuclei are very close to 0.5, which is also the rotational value for a K=0 band. But we also note that we get close to 0.5 in the single j shell model for intermediate and heavy nuclei. In single j the expression for j=1+1/2 is g=0.5+0.38/(2l+1) while for j=1-1/2 it is g=0.5-0.38/(2l+1). Hence from a measured value close to 0.5 one cannot conclude that the rotational model or the single j shell model are approximately correct, or whether one needs or does not need intruder state admixtures. Odd-odd nuclei are also considered where the situation is similar. For closed major shell plus or minus one nucleon there are no first order corrections and the second order ones are due to the tensor force.

11:06AM ME.0004 High-lying, non-yrast shell structure in 52Ti, SHAOFEI ZHU, R.V.F. JANSSSENS, M.P. CARPENTER, B.P. KAY, F.G. KONDEV, T. LAURITSEN, C.J. LISTER, A. ROBINSON, D. SEWERYNIK, X. WANG, Argonne National Laboratory, B. FORNAL, R. BRODA, W. KROLSA, T. PAWLAT, J. WRZESINSKI, Institute of Nuclear Physics, Poland, S.J. FREEMAN, A. DEACON, J.F. SMITH, B.P. KAY, LISA GERHARDT, Lawrence Berkeley National Laboratory, ICECUBE COLLABORATION — Study of High pT Muons with IceCube Muons with a large transverse momentum (pT) are produced in cosmic ray air showers via semileptonic decays of heavy quarks and the decay of high pT kaons and pions. These high pT muons will have a large lateral separation from the shower core. IceCube, a neutrino telescope consisting of a three-dimensional array of photodetectors buried in the ice of the South Pole and a surface air shower array, is well suited for the detection of high pT muons. The surface shower array can determine the energy, location and direction of the cosmic ray air shower while the IceCube array can do the same for the high pT muon. This makes it possible to measure the average separation as well as the shape of the pT spectrum of these muons which can be used to probe the composition of high energy cosmic rays.

1This work was supported by the U.S. Department of Energy, Office of Nuclear Physics, under Contract No. DE-AC02-06CH11357.
11:18AM ME.00005 First detailed structure information on the r-process path nucleus $^{63}$Fe. A. BALUYUT, U. of Notre Dame, H. MACH, Upssala U., E. RUCHOWSKA, SINS, Swierk, U. KOESTER, ILL, Grenoble, L.M. FRAILE, U. Complutense Madrid, H. BRADLEY, U. of Sydney, R. BOUTAMI, CSIC Madrid, N. BRAUN, CH. FRANSEN, U. of Cologne, E.M. REILLO, CSIC Madrid, V. UGRYUMOV, NPI, Rez — The nucleus $^{63}$Fe is located exactly at the point of transition between lighter Fe isotopes which show spherical structures and heavier Fe, where a sudden increase in quadrupole collectivity is manifest from lowering of the first excited $2^+$ states in the even Fe nuclei. Very little is actually known on the exotic neutron-rich nuclei in this region. A substantial modification of information on the nuclear structure of $^{63}$Fe and nuclei in its vicinity was obtained from a fast timing study conducted at the ISOLDE facility at CERN where levels in $^{63}$Fe were populated from the beta-decay of $^{63}$Mn. The new level scheme of $^{63}$Fe includes 21 gamma-transitions and 10 excited states. Although $^{63}$Fe seems to be understood in a shell model picture, a clear departure from spherical sequence is observed. From the measured level energies, gamma-ray branching ratios, and level half-lives in the ps range, we deduce spins and parities of $1/2^-$, $3/2^-$ and $5/2^-$ for the lowest states in $^{63}$Fe which represent an inverted sequence in comparison to the heavier (and spherical) $N = 37$ isotones, namely $^{65}$Ni and $^{67}$Zn.

11:30AM ME.00006 Measurements of the g-factors of the $4^+$ states in $^{72,76}$Ge isotopes. G. GÜRDAL, G. KUMBARTZKI, N. BENCZER-KOLLER, Y.Y. SHARON, Rutgers University, Z. BERANT, WNSL, Yale University; Nuclear Research Center Negev, Israel, R. CASPERSON, A. HEINZ, G. HENNING, J. QIAN, A. SCHMIDT, J.R. TERRY, W. WERNER, E. WILLIAMS, R. WINKLER, WNSL, Yale University — In this work, the g-factors of the excited $4^+$ states of $^{72,76}$Ge were measured, using the Transient Field (TF) technique, and the results will be presented. The $4^+$ states of $^{72,76}$Ge were populated by using projectile excitation. The $^{72,76}$Ge beams were accelerated to 200 MeV at the Yale Tandem accelerator and were Coulomb excited as they interacted with a Mg target. The systematic studies of the g factors of $2^+$ and $4^+$ nuclear states provide an understanding of the microscopic structure of the wave functions of these low-lying excited states, since the g factors are very sensitive to the proton and neutron configurations in the wave functions. The measured g factor results can be compared to the predictions of either large-scale shell model calculations or of collective models. The measured g factors of the $2^+$ states in the Ge isotopes show reasonable agreement with the $Z/A$ values that are characteristic of collective behavior. The lack of data for the g factors of the corresponding $4^+$ states motivated the present investigations. Work supported by the U.S. National Science Foundation and U.S.D.O.E under grant DE-FG02-91ER-40609.

11:42AM ME.00007 Investigating nuclear structure relevant to neutrinoless double $\beta$ decay: $^{76}$Ge and $^{76}$Se. 1. B.P. KAYEN, J.P. SCHIFFER, K.E. REHM, ANL, S.J. FREEMAN, Manchester, J.A. CLARK, C.M. DEIBEL, C. WREDE, Yale, A.C.C. VILLARI, GANIL, P. GRABMAYR, Tubingen, T. ADACHI, H. FUJITA, Y. FUJITA, K. HATANAKA, D. ISHIKAWA, Y. MEADA, H. MATSUBARA, H. OKAMURA, Y. SAKEMI, Y. SHIMIZU, H. SHIMODA, K. SUDA, Y. TAMESHIGE, A. TAMII, RCPN Osaka — Disagreements between theoretical predictions of matrix elements relevant to neutrinoless double beta decay motivated measurements of valence occupations in the ground states of $^{76}$Ge and $^{76}$Se. Results from neutron transfer reactions indicate that the Fermi surface is much more diffuse than theoretical calculations suggest. Recently, similar measurements have been carried out to determine the difference in proton occupations of these nuclei. This program of work is complemented by results probing pair correlations in these nuclei, obtained using the (p,t) reaction. a J.P. Schiffer et al. Phys. Rev. Lett. 100, 112501 (2008) b S.J. Freeman et al. Phys. Rev. C 75, 051301(R) (2007)

11:54AM ME.00008 Photon Scattering from the Stable Even-Mass Mo Isotopes Below the Neutron-Separation Energy. G. RUSEV, A. HUTCHESON, E. KWN, A.P. TONCHEV, W. TORNOW, Duke and TUNL, C. ANGELL, S. HAMMOND, H.J. KARWOWSKI, UNC and TUNL, J.H. KELLEY, NCUS and TUNL, R. SCHWENGNER, F. DONAU, A. WAGNER, FZD — We present results from photon scattering experiments on the stable even-mass molybdenum isotopes below the neutron-separation energy carried out with bremsstrahlung at the superconducting electron accelerator ELBE at the Research Center Dresden-Rossendorf in Germany, and with monoenergetic photon beams at the HfS facility at TUNL. We applied statistical methods in order to correct for the branching and cascade transitions and to determine the photoabsorption cross section. The obtained results allowed us to extend the tail of the Giant Dipole Resonance below the $\gamma,n$ threshold down to 4 MeV. The photoabsorption cross sections deduced from the present experiments show that the dipole strength increases with the neutron number of the Mo isotopes. The experimental results are shown in the frame of Quasiparticle-Random-Phase-Approximation in a deformed basis which describe the increasing strength as a result of the deformation.

Sunday, October 26, 2008 10:30AM - 12:18PM — Session MF Baryon Resonances in Hadronic Physics Simmons Ballroom 4

10:30AM MF.00001 Coupled-channel analysis of hadronic and electromagnetic $\pi$, $\eta$, two-$\pi$ production reactions1. H. KAMANO, EBAC@JLab, B. JULIA-DIAZ, EBAC@JLab, Univ. of Barcelona, T.-S. H. LEE, EBAC@JLab, Argonne National Lab, A. MATSUYAMA, EBAC@JLab, Shizuoka Univ., T. SATO, EBAC@JLab, Osaka Univ. — Recent high precision data of the electromagnetic meson production reactions off nuclei from Bonn, GRAAL, JLab, Mainz and Spring-8 make possible to extract $Q^2$ dependence of the electromagnetic $N^*N^*$ transition form factors. To extract such information on the quark-gluon structures of the $N^*$ states, a comprehensive analysis of the hadronic and electromagnetic meson production reactions is ongoing in Excited Baryon Analysis Center (EBAC) at JLab. The analysis is based on the dynamical coupled-channel model which properly describes correlations among all relevant reaction channels required from unitarity and can treat non-resonant and resonant processes in a unified manner. In this talk, we will report current status on the analysis of $eN \rightarrow \pi N$, $\gamma N \rightarrow \eta N$ and $eN \rightarrow e\pi N$ reactions. The main purpose is to determine parameters associated with the electromagnetic interactions by this combined analysis of the electromagnetic meson production reactions. We will also discuss the $N^*N^*$ electromagnetic form factors extracted from the analysis of the $eN \rightarrow e\pi N$ reaction.

1Supported by DOE, Office of Nuclear Physics, under contract No. DE-AC02-06CH11357 and No. DE-AC05-060R23177.
10:42AM MF.00002 π⁺ photoproduction on the proton from 0.675 to 2.875 GeV
BARRY RITCHIE, Arizona State University, CLAS COLLABORATION — Differential cross sections for the reaction γ + p → n + π⁺ have been measured with the CEBAF Large Acceptance Spectrometer (CLAS), a tagged photon beam with energies from 0.675 to 2.875 GeV, and a cryogenic hydrogen target. The reaction channel was isolated by detecting the photoproduced pion and identifying the recoil neutron through the missing mass technique, assuming γ + p → π⁺ + X. Photon energy bin widths were 50 MeV, and absolute normalization uncertainties for these differential cross sections were less than 5% at all energies studied. These cross sections complement and extend the existing data for the process. Data from this experiment were included in a SAID fit and compared with MAID and previous experiments. The impact of this new data set will be discussed.

3Work at Arizona State University is supported by the U.S. National Science Foundation.

10:54AM MF.00003 Photon beam asymmetries for π⁰ and π⁺ photoproduction from the proton
MICHAEL DUGGER, Arizona State University, CLAS COLLABORATION — Pion photoproduction data have been vital to uncovering details of the nucleon resonance spectrum. The pions, as the lightest mesons, are copiously produced in the strong interaction. However, while pion photoproduction data is an important fundamental tool in baryon spectroscopy, the existing data set still remains relatively limited, and the existing database is dominated by measurements of the differential cross sections. I will present preliminary Jefferson Lab data on photon beam asymmetry for both the π⁰ and π⁺ reactions for energies up to about E = 2.1 GeV. The kinematic range of these measurements both complements and extends the world database for these reactions.

3The work at Arizona State University is supported by the U.S. National Science Foundation.

11:06AM MF.00004 Beam asymmetry in η meson photoproduction from the proton
PATRICK COLLINS, Arizona State University, CLAS COLLABORATION — The excitation spectrum of the proton is comprised of many broad overlapping resonances. Due to this feature, investigations of individual resonances are challenging. One excellent tool in helping understand the spectrum is η meson photoproduction from the proton. Because this meson has isospin zero, it can be seen as an “isospin filter” for the nucleon resonance spectrum. Differential cross section data has been the primary tool used to study η meson photoproduction. However, these beam asymmetries cover the energy range up to only about Eγ = 1.5 GeV. I will present preliminary Jefferson Lab CLAS data on beam asymmetry for the η meson for energies up to about Eγ = 2.1 GeV. I will also discuss how the new measurements will be useful in understanding the structure and excited states of the proton.

3Work at Arizona State University is supported by U.S. National Science Foundation.

11:18AM MF.00005 Dynamical coupled channel calculation of pion and omega production
MARK PARIS, Jefferson Lab — The dynamical coupled channel approach developed at the Excited Baryon Analysis Center is extended to include the ωN channel to study π and ω—meson production induced by scattering pions and photons from the proton. Six intermediate channels, including πN, ηN, πΔ, πN, πN, ωN, are employed to describe unpolarized and polarized data. Bare parameters in an effective hadronic Lagrangian are determined in a fit to the data for πN → πN, γN → πN, πN → ωN, and ωN → ωN reactions at center-of-mass energies from threshold to W < 2.0 GeV. The 7 matrix determined in these fits is used to calculate the photon beam asymmetry for theω—meson production and the ωN → ωN total cross section and ωN scattering lengths. The calculated beam asymmetry is in good agreement with the observed in the range of energies near threshold to W < 2.0 GeV.

3This work is supported by the U.S. Department of Energy, Office of Nuclear Physics Division.

11:30AM MF.00006 Σ⁺(1385) photoproduction on proton
GAGIK GAVALIAN, M. AMARIAN, ODU, CLAS COLLABORATION — The search for missing resonances using coupled channel analysis, Nπ and Kγ, has been ongoing project at CLAS (Jefferson Lab). In this analysis the differential cross sections for the reaction γp → K⁺Σ⁺(1385) have been measured with CLAS. The differential cross sections and the angular dependence of the K⁺ in the reaction center of mass frame are obtained using a tagged photon beam with photon energies from 1.5 GeV to 3.6 GeV. The cross sections and angular dependences will be compared with theoretical predictions using Kγ coupling to known and missing resonances.

11:42AM MF.00007 Photoproduction of Λ(1520) and interference effect in particle production
CHANDRA NEPAL, MOSKOV AMARIAN, GAGIK GAVALIAN, Old Dominion University, CLAS COLLABORATION — The cross-sections and t-dependence of two decay channels: Λ(1520) → K⁻p and Λ(1520) → K⁺n are investigated to unravel quantum mechanical interference between Λ(1520)(K⁻p) and Ω(1520)(K⁺K⁻) decay modes, which is absent in Λ(1520) → K⁺n final state. The data set collected on hydrogen target in the photon energy range from 1.5 - 3.6 GeV on CLAS are used for this analysis.

11:54AM MF.00008 Differential cross sections for γp → π⁺π⁻ using CLAS
MATTHEW BELLIS, Stanford University, CLAS COLLABORATION — The Constituent Quark Model predicts multipoles which are absent from the observed spectra. These states may couple strongly to Λπ and pπ, both of which appear as intermediate states in π⁺π⁻. The g1c experiment used the CLAS detector to collect data using brehmsstrahlung photons (0.8-2.4 GeV) directed onto a liquid hydrogen target and collected over 10 million events for this 2π final state alone. The challenge with this analysis is not the statistics, but the 3-body nature of the reaction and the overlapping intermediate states produced. The finite coverage of most detectors also introduces holes in the acceptance which can lead to ambiguities in the extrapolation of the physics solution. We attack this problem by observing the final state in multiple ways: by missing any of the three particles (p, π⁺, π⁻) in the detector and reconstructing it from missing mass as well as detecting all three tracks. We require a physics solution to be consistent amongst all 40 topologies in order to achieve full coverage of the phase space. This allows us to quote differential cross sections for this reaction in two-body masses (dσ/dM(X)), center-of-mass production angles (dσ/dcos(θ_i)), and helicity angles (dσ/dcos(θ_i), dσ/dhel) These measurements achieve at a higher sensitivity than has previously been reported and will provide valuable input for extracting resonance information at later stages of analysis.
10:42AM MG.00002 12B(n,g) - The Influence on r-process Nucleosynthesis of Light Elements

10:54AM MG.00003 Reconstructing the 10(γ,α)12C Events in the HI-S Optical Readout Time Projection Chamber

11:06AM MG.00004 New Measurements of spectroscopic factors for low-lying 16N levels

11:18AM MG.00005 Breakup of proton-rich nuclei 24Si, 23Al, 22Mg, 21Na at intermediate energies for reaction rates in explosive H-burning in novae
11:30AM MG.00006 Study of the hindrance effect in sub-barrier fusion reactions. PAUL DAVIES, University of Surrey, ANSEL HILLMER, Valparaiso University, ANTONIOS KONTOS, LARRY LAMM, CHI MA, University of Notre Dame, EDWARD MARTIN, University of Surrey, MASASHIRO NOTANI, FRANCESCO RAIOLA, ED STECH, WANPENG TAN, XIAODONG TANG, University of Notre Dame — In recent years, a hindrance model has been proposed to extrapolate heavy-ion fusion cross sections at sub-barrier bombarding energies. Compared to the single- and coupled-channel model, the hindrance model greatly reduces the fusion reaction rates in the stellar matter at temperatures $T \lesssim (3-10) \times 10^9$ K. To test the hindrance model, we have measured the cross sections for the reaction $^{12}$C($^{12}$C,p)$^{24}$Na in the energy range $E_{cm} = 3.08-4.80$ MeV by counting the beta-gamma coincidence from the decay of $^{24}$Na which has a half life of 15 hours. Preliminary results will be presented.

11:42AM MG.00007 Probing Nucleosynthesis in Novae: $^{22}$Na(p,$\gamma$)$^{23}$Mg. A.L. SALLASKA, D.W. STORM, A. GARCIA, T.A.D. BROWN, K.A. SNOOVER, C. WREDE, K. DERYCKX, University of Washington, C. RUIZ, D.A. HUTCHEON, L. BUCHMANN, D.F. OTTENWELL, C. VOCKENHUBER, TRIUMF, J.A. CAGGIANO, PNNL — Orbiting gamma ray telescopes have yet to observe the elusive $^{22}$Na isotope. More sensitive observations are planned, and present uncertainties in the dominant destructive reaction, $^{22}$Na(p,$\gamma$), suggest new measurements in the proton energy range of 150 to 300 keV are needed to clarify the predictions of the amount of $^{22}$Na expected in a nova explosion. In particular, a state in $^{23}$Mg reported by Jenkins [1] implies a possible resonance at $E_p = 198$ keV which could be significant. We are in the process of measuring the $^{22}$Na(p,$\gamma$) reaction rate directly by using protons from the UW tandem on a specially designed beamline, which includes rastering and cold vacuum protection of the $^{22}$Na implanted targets, fabricated at TRIUMF. A multitude of target tests have been performed with stable $^{23}$Na, focusing on sodium stability with respect to sputtering and heating caused by the high intensity beam. Utilizing two 100% Ge detectors with anticoincidence shields to reduce cosmic backgrounds, preliminary measurements have been performed on known resonances of $^{22}$Na, as well as on the proposed new resonance. Results will be presented. [1] Jenkins et al., PRL 92 (2004) 031101

11:54AM MG.00008 Lowest l=0 Proton-Resonance in 26Si and Implications for Nucleosynthesis of 26Al. P.N. PEPLOWSKI, L.T. BABY, E. DIFFENDERFER, P. HOFLICH, N. KEELEY, A. ROJAS, A. VOLYA, I. WIEDENHÖVER, Florida State University, FLORIDA STATE UNIVERSITY TEAM — The first successful experiment to determine the 25Al(p,gamma)26Si reaction rate using a radioactive beam of 25Al is presented here. The experiment was carried out using the new in-flight radioactive beam production facility, known as RESOLUT, at The Florida State University. The analogous single proton transfer reaction d(25Al,26Si)n was measured. Details of the RESOLUT beamline and detection scheme for the experiment will be discussed. Results from this experiment, including implications for the rp-process and stellar nucleosynthesis of 26Al will be presented.

12:06PM MG.00009 Measurement of Low Energy Resonances in $^{31}$P(p,$\alpha$)$^{28}$Si. B.H. MOAZEN, Univ. of Tenn., C. MATEI, ORAU, D.W. BARDAYAN, ORNL, J.C. BLACKMON, LSU, K.Y. CHAE, Univ. of Tenn., K.A. CHIPPS, Colorado School of Mines, R. HATARIK, Rutgers, K.L. GRZYWACZ, R.W. KAPLER, Univ. of Tenn., R.L. KOZUB, Tenn. Tech., Univ., M. MATOS, LSU, C.D. NESARAJA, S.D. PAIN, Univ. of Tenn./ORNL, T. PELHAM, Univ. of Surrey, W.A. PETERS, Rutgers, S.T. PITTMAN, Univ. of Tenn., J.F. SHRINER JR., Tenn. Tech. Univ., M.S. SMITH, ORNL — The (p,$\alpha$) reactions on T=1/2 nuclei like $^{23}$Na, $^{27}$Al, $^{31}$P, and $^{35}$Cl, and the competing (p,$\gamma$) reactions are important for understanding the reaction flow to heavier elements in the rp-process. Previous rate calculations of the $^{31}$P(p,$\alpha$)$^{28}$Si reaction were based on indirect information gained from studies of the $^{31}$P($^3$He,d)$^{28}$Si reaction [1]. At ORNL, we measured the energy and strength of the 371 and 599 keV resonances in $^{31}$P(p,$\alpha$)$^{28}$Si using a technique previously employed for an $^{17}$O(p,$\alpha$)$^{14}$N study[2]. A beam of $^{31}$P bombarded hydrogen gas which filled a large, differentially pumped scattering chamber at a pressure of 3 Torr. The alpha particle and $^{28}$Si recoil were detected in coincidence and the reaction vertex was determined using the relative kinematics of the reaction products. The experimental setup and preliminary results will be presented. [1] Ross et al., Phys. Rev C 52, 1681 (1995) [2] B. H. Moazen et al., Phys. Rev. C 75, 065801 (2006) ORNL is managed by UT-Battelle for the US DOE

Sunday, October 26, 2008 10:30AM - 12:06PM – Session MH Instrumentation II – Jewett Ballroom F

10:30AM MH.00001 The HELIOS silicon detector array. S.T. MARLEY, Western Michigan University, HELIOS COLLABORATION — A prototype detector array has been constructed for use in the Helical Orbit Spectrometer (HELIOS) at the ATLAS facility at Argonne National Laboratory. HELIOS is a high-resolution spectrometer for use in studying reactions in inverse kinematics on hydrogen or helium targets. HELIOS consists of a large bore, 3T superconducting solenoid oriented with the magnetic and beam axes aligned. The detector array is comprised of four modules each with six 1.2 x 5.6 cm position sensitive silicon detectors. On each module, the detectors were affixed with conductive epoxy and wire bonded to custom made multi-layer printed circuit boards. To keep the radial extent of the detectors to a minimum, the modules were assembled on a hollow 1.6 x 1.6 x 68.8 cm aluminum rail centered on the beam axis located upstream from the target. To characterize the timing, position, and energy resolutions, the detectors were evaluated at the Western Michigan University Accelerator Laboratory using elastic proton-proton scattering. The construction, assembly and preliminary testing of the array will be discussed.

10:42AM MH.00002 Algorithms for Pulse Shape Analysis Using Silicon Detectors. IAIN DARBY, SEAN LIDDICK, University of Tennessee, ROBERT GRZYWACZ, University of Tennessee; Physics Division Oak Ridge National Laboratory — The development of digital pulse processing, wherein the traditional shaping and timing circuitry are replaced by mathematical routines operating on a digitized preamplifier signal, have enabled the implementation of sophisticated pulse shape analysis (PSA) algorithms. This allows substantially more information to be extracted from an experimental pulse than is possible with a traditional analogue system. By applying PSA to Si detectors it is possible to selectively identify experimental pulses arising from specific physical processes. The application of pulse-shape analysis to Silicon strip detectors will be described for the selective identification of pile-up pulses resulting from the sequential $\alpha$-decay of $^{109}$Xe and $^{109}$Te isotopes. A two stage offline PSA algorithm is detailed, which is able to detect pile-up pulses from the sequential alpha decays with time differences between the two individual pulses as low as 100 ns over a wide range of relative amplitudes. The methods to construct idealised pulses and the subsequent extraction of energy and time from experimental measurements will be presented.

10:54AM MH.00003 ABSTRACT WITHDRAWN –
techniques. using a Michelson interferometer are being explored that would provide immediate feedback on crystal flatness and enable rapid studies of different mounting the way the crystal is mounted and from internal defects, can produce significant warping which degrades the coherent edge and polarization of the beam. As possible to reduce the effects of multiple scattering on the photon beam divergence. At thicknesses below 100 microns, stresses on the diamond, both from 

Our goal is to be able to induce enough polarization into the beam (a few percent is sufficient) to enable 

β beams, we would be able to extend magnetic dipole moment measurements of ground states toward the r-process nuclei above 78

γ-rays can result in systematic errors in determination of the β-decay strength distribution—the “Pandemonium Effect” [1]. To circumvent this issue, we are developing a TAGS to be used in conjunction with the CARIBU facility at ANL. The TAGS is a large-volume NaI(Tl) detector with a central well in which the active source is positioned [2], resulting in over 90% γ-ray detection efficiency. A Si detector can additionally be placed within the well to allow β-tagging of the events. The information thus obtained has relevance for better characterization of the total decay heat produced in advanced nuclear reactors and for astrophysics applications. Progress on the development of TAGS at ANL will be presented. [1] J.A.Hardy et al., Phys. Lett. B71, 307 (1977). [2] R.C.Greenwood et al., Nucl. Inst. Meth. A314, 514 (1992).

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Compact β-NMR set-up using tilted-foil polarization[1], C.J. GROSS, K.P. RYKACZEWSKI, J.W. JOHNSON, S.W. MOSKO, A.J. MENDEZ II, D. SHAPIRA, J.F. LIANG, R.L. VARNER, ORNL, N. BENZER-KOLLER, G. KUM-BARTZKI, Rutgers U., M. HASS, Weizmann Inst., P.F. MANTICA, Mich. St., R. GRZYWACZ, S.N. LIDDICK, U. Tenn., C.R. REED, J.C. BATECHELER, UNIRIB, J.A. WINGER, Miss. St. — We are developing polarized radioactive ion beams for use in β-NMR measurements. Polarization will be induced via the multi-tilted-foil method developed in the late 70’s and 80’s. Neutron-rich Cu and Ga radioactive beams will be accelerated to a few MeV and passed through a series of thin carbon foils tilted ~75° with respect to the beam. Subsequent atomic polarization can be transferred to the nucleus through hyperfine coupling. Our goal is to be able to induce enough polarization into the beam (a few percent is sufficient) to enable β-NMR studies. If successful with HRIBF neutron-rich beams, we would be able to extend magnetic dipole moment measurements of ground states toward the r-process nuclei above 78Ni. A proof-of-principle experiment of the beam polarization process has been demonstrated by Bendahan et al. [Z. Phys. A 331, 343 (1988)]. It is hoped that a small compact system using permanent magnets will permit the use of Ge detectors to select specific isotopes in the beam.

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