2007 Annual Meeting of the Division of Nuclear Physics
Newport News, Virginia
http://www.aps.org/meetings/meeting.cfm?name=DNP07
Wednesday, October 10, 2007 9:00AM - 1:30PM –
Session 1WA Workshop on Electroweak and Precision Physics I
Newport News Marriott at City Center Pearl Salon I

9:00AM 1WA.00001 WELCOME/INTRO –

9:05AM 1WA.00002 Electroweak and Precision Physics: Overview
DAVID HERTZOG, University of Illinois at Urbana-Champaign — Probing for new physics using the approach of low-energy precision measurements is a fertile ground for discovery. What is the nature and mass of the neutrino? How is it that we live in a matter dominated universe? What extensions to the standard model are required? These fundamental questions are being addressed by tools that include sensitive searches for highly suppressed processes, and by precision measurements of accurately calculated standard model quantities. I will introduce the framework for a broad program of efforts where nuclear physicists play leading roles. These include neutrinoless double beta decay, neutron decay correlations and lifetime, EDM searches in several systems, beta-decay of trapped nuclei, precision muon parameter measurements, and parity-violating electron scattering.

9:55AM 1WA.00003 Neutrinoless Double Beta Decay: a Window on the Origin of Neutrino Mass
CARTER HALL, University of Maryland — The discovery of neutrino oscillations has had a profound effect on our understanding of fundamental physics. Oscillation data have proven the existence of finite neutrino mass, and resolved three decades of experimental anomalies in solar and atmospheric neutrino measurements. On the other hand, the scale of neutrino mass implied by the data creates a new hierarchy problem for particle physics. Why are neutrinos so light compared to the quarks and charged leptons? Our best tool for addressing this question is the neutrinoless double beta decay process, which can constrain the absolute value of the neutrino masses, and more importantly, may shed light on the origin of those masses. This talk will review the current status and future plans of double beta decay experiments in the US and abroad, with emphasis on the EXO experiment.

10:30AM 1WA.00004 COFFEE BREAK –

11:00AM 1WA.00005 Latest Results on Muon Decay from the TWIST Experiment
ROBERT TRIBBLE, Texas A&M University — The TRIUMF Weak Interaction Symmetry Test (TWIST) collaboration is searching for deviations from predictions of the Standard Model (SM) in polarized muon decay via precision measurements of the energy and angle for decay positrons. Measurements of muon decay parameters with high statistics ensure that the space-time structure of the low-energy weak interaction can be tested to the level of systematic uncertainties. Our goal is to improve the measurements of the muon decay parameters, \( \rho, \delta \) and \( P_\mu \), by an order of magnitude over previous measurements thereby achieving sensitivity to physics beyond the SM at a level of a few parts in \( 10^4 \). First results for the three parameters have been reported \cite{1} which yield measurements that improve their precision by about a factor of three. Analysis is nearly complete for newer measurements of \( \rho \) and \( \delta \) which should result in improvement by another factor of two in their precision. The experiment will be described, results of the most recent analyses will be presented and the expectations for the final results will be discussed.


1Supported in part by the U.S. Department of Energy.

11:35AM 1WA.00006 MuLan; a precision measurement of the muon lifetime and determination of the Fermi constant
TIM GORRINGE, Univ. of Kentucky — The Fermi constant \( G_F \) determines the rates of weak processes that range from nuclear beta-decay to stellar nucleo-synthesis. At Paul Scherrer Institute, the MuLan experiment is seeking to determine the Fermi Constant by measuring the positive muon lifetime to an unprecedented precision of about one part-per-million - a twenty-fold improvement over earlier experimental efforts. The experiment uses an intense, pulsed, muon beam and a finely-segmented, fast-timing, scintillator array to record the decays of more than \( 10^{12} \) muons. In this talk we report the results for the positive muon lifetime from our 2004 production run, and describe our progress to reaching the final goal of one ppm. The implications - both as a determination of a fundamental constant of the electroweak interaction and for the precision testing of the standard model - are also discussed.

12:10PM 1WA.00007 LUNCH –

Wednesday, October 10, 2007 9:00AM - 1:30PM –
Session 1WB Workshop on Hard Scattering Processes and 3D Parton Distributions I
Newport News Marriott at City Center Pearl Salon II/III

9:00AM 1WB.00001 WELCOME/INTRO –

9:05AM 1WB.00002 Hard Exclusive Processes and GPDs
ANATOLY RADYUSHKIN, ODU/JLab — Applications of perturbative QCD to deeply virtual Compton scattering and hard exclusive electroproduction processes require a generalization of the usual parton distributions for the case when long-distance information is accumulated in nondiagonal matrix elements of quark and gluon light-cone operators. I describe two types of generalized parton distributions, nonperturbative functions parametrizing such matrix elements: double distributions and off-forward parton distributions. I discuss their general properties, relation to the usual parton densities and form factors, evolution equations for both types of generalized parton distributions (GPD), models for GPDs, their applications in virtual and real Compton scattering, and recent achievements in the studies of GPDs.

9:55AM 1WB.00003 Spin Orbit Correlations
M. BURKHARDT, New Mexico State University — I discuss the physical interpretation for generalized parton distributions (GPDs) with special focus on those GPDs that describe parton asymmetries in impact parameter space. The chirally odd GPD \( E_T(x,0,-\Delta^2) \) describes the transverse deformation of the distribution of unpolarized quarks in a transversely polarized nucleon. In combination with an attractive final state interaction (FSI) this deformation can explain the Sivers effect in SIDIS. The chirally odd GPD \( E_T(x,0,-\Delta^2) \) describes the deformation of the distribution of transversely polarized quarks in an unpolarized target. I will explain the physics associated with the sign of \( E_T \) and its implications for measurements of the Boer-Mulders function.

10:30AM 1WB.00004 COFFEE BREAK –
11:00AM 1WB.00005 TMD Studies at JLab, HARUT AVAKIAN, JLab — In recent years parton distributions, describing longitudinal momentum, helicity and transversity distributions of quarks and gluons, have been generalized to account also for transverse momentum distributions of partons, providing important information on the spin correlations of partons in the nucleon. Great progress has been made since then in measurements of different Single Spin Asymmetries (SSAs) in semi-inclusive processes providing access to Transverse Momentum Dependent (TMD) parton distributions. Different facilities world-wide including HERMES at HERA, CLAS and Hall-A at JLab and COMPASS at CERN have measurements of semi-inclusive processes as one of their main focuses of research. TMD studies are also becoming an important part of future Drell-Yan experiments at JPARC and GSI. SSA measurements performed at HERMES, COMPASS and CLAS with polarized beams and targets provide access to different combinations of TMDs allowing the separation of different contributions from global analysis of the data. In addition, measurements of spin-orbit correlations with different pseudoscalar mesons in a wide kinematical range provide sensitivity to flavor dependence of TMDs. In this talk we present an overview of the latest developments in studies of TMDs at JLab and discuss newly released results, ongoing activities, as well as planned near term and future measurements.

11:35AM 1WB.00006 Generalized Parton Distribution studies at Jefferson Lab, FRANCK SABATIE, CEA Saclay — After about 10 years of strong interest for Generalized Parton Distributions (GPD) come the first significant results from several dedicated experiments from Jefferson Lab. Most of them used the golden Deeply Virtual Compton Scattering (DVCS) process in order to access the GPDs but new and interesting results are also available in the deep electroproduction of mesons. I will give an overview of these measurements, with particular focus on the new results from Hall A and B, and try to paint an overall picture of how well we understand all these new data in the GPD framework. The summary will include an outlook on the next generation of experiments which are already planned at Jefferson Lab with 6 GeV beam, but also after the 12 GeV upgrade.

12:10PM 1WB.00007 LUNCH —

Wednesday, October 10, 2007 2:00PM - 5:15PM — Session 2WA Workshop on Electroweak and Precision Physics II Newport News Marriott at City Center Pearl Salon I

2:00PM 2WA.00001 Scalar and right-handed current searches using trapped atoms, DAN MELCONIAN, University of Washington — Neutral atom traps coupled to a radioactive ion beam facility can be used to provide an ideal source of β decaying atoms: the atoms are cold, compact, and the daughter particles escape the source with negligible distortions to their momenta. By measuring the β − ν correlation parameter in the $1^+ \to 0^+$ decay of $^{38}$K, the TRINAT collaboration has improved the limits on possible scalar currents (Gorelov, et al., Phys. Rev. Letts. 94 (2005) 142501). We have recently demonstrated the ability to highly polarize laser-cooled atoms and to search for right-handed currents by measuring the neutrino asymmetry parameter in the $I^=\frac{3}{2}^+$ decay of $^{17}$K (Melconian et al., Phys. Lett. B 649 (2007) 370). A summary of these experiments and the planned improvements will be presented.

2:35PM 2WA.00002 The Search for the Neutron Electric Dipole Moment, BRAD FILIPPONE — A non-zero neutron Electric Dipole Moment (EDM) would indicate a violation of Time Reversal Symmetry and, via the CPT Theorem, also a violation of Charge Conjugation/Parity (CP) symmetry. New experiments are underway to increase the sensitivity to a neutron EDM to $\sim 1 \times 10^{-28}$ e-cm, representing an improvement over the existing limits of about two orders-of-magnitude. A positive result from these experiments would imply that new sources, beyond our present Standard Model, of CP violation must exist. I will discuss the progress and plans for a new neutron EDM experiment to be carried out at the Fundamental Neutron Physics Beamline at the Spallation Neutron Source.

3:10PM 2WA.00003 COFFEE BREAK —

3:30PM 2WA.00004 aCORN: A Precision Measurement of the Neutron Decay a-Coefficient†, FRED WIEFTFELDT, Tulane University — The experimental parameters of neutron beta decay can be used to measure the weak coupling constants $g_A$ and $g_V$, determine the CKM matrix element $V_{ud}$, and search for hints of non-Standard Model physics. The aCORN experiment will make a precision ($<1\%$) measurement of the electron-antineutrino angular correlation (a-coefficient). It uses a new method in which the a-coefficient is proportional to an asymmetry in beta-proton coincidence count rates. Precision spectroscopy of recoil protons, which has systematically limited previous experiments at the 5% level, is not necessary in aCORN. The apparatus is currently under construction. It will be integrated and tested at the new LENS facility at Indiana University and then moved to the NIST Center for Neutron Research in 2008 for the initial physics run.

†Work supported by the National Science Foundation.

2(for the aCORN collaboration)

4:05PM 2WA.00005 An Experiment to Measure the Proton’s Weak Charge, DAVID MACK, Thomas Jefferson National Accelerator Facility — Precision measurements of Standard Model-suppressed, weak-scale observables provide a window on potential new physics at the TeV scale. An attractive observable is the proton neutral weak charge, $Q_{W_{\text{Weak}}}^{p}$, which measures the coupling of the Standard Model Z boson to the proton and is proportional to the relatively small quantity $1 - 4\sin^2 \theta_W$. The proton weak charge can now be calculated to very high precision in the Standard Model but has never been measured directly. Its value could be significantly shifted by new, parity-violating electron-quark interactions such as those found in leptoquark models or RPV SUSY models. The existence of new Z’s could also shift the observed value. By measuring the parity-violating asymmetry in elastic $e + p$ scattering at low momentum transfer, the proton weak charge can be determined with hadronic ambiguities which are significantly smaller than our projected error bar. After overviewing the physics and our plans for a $Q_{W_{\text{Weak}}}^{p}$ measurement, the status of the construction effort will be summarized.
4:40PM 2WA.00006 Probing the TeV Scale with Parity-Violating Electron Scattering: New Opportunities with the 12 GeV Upgrade. KRISHNA KUMAR, University of Massachusetts, Amherst — The technique of parity-violating electron scattering, involving measurements of the asymmetry in the scattering of longitudinally polarized electrons off fixed targets, has become increasingly precise and broad in its scope over the past two decades. Such asymmetries are sensitive to weak neutral current interactions between electrons and target particles, mediated by the Z boson, and are being used to investigate the strangeness content of the nucleon, the neutron distribution in heavy nuclei and to probe for the limits of the validity of the electroweak theory in a manner complementary to direct searches for new physics at high energy scales at colliders.

At Jefferson Laboratory, experimental techniques have now been developed, that allow for asymmetries to be measured with statistical and systematic errors approaching 1 part per billion. With the completion of the 12 GeV upgrade, further precise measurements become feasible, in parity-violating deep inelastic scattering and in electron-nucleon (Møller) scattering. In particular, the latter measurement could potentially lead to the best measurement of the electroweak mixing angle $\sin^2\theta_W$ at low energy, with precision equal to or better than the two best collider measurements. In deep inelastic scattering, apart from testing the electroweak theory, the measurements would provide new precision probes of the high-$x$ structure of the nucleon by testing for the onset of charge symmetry violation and allowing a clean and accurate measurement of $d(x)/u(x)$ as $x \to 1$. In this talk, we will first give an introduction to the experimental technique and report on recent developments. We will then elaborate on the physics motivation for the abovementioned program of new measurements in detail.

Wednesday, October 10, 2007 2:00PM - 5:15PM — Session 2WB Workshop on Hard Scattering Processes and 3D Parton Distributions II Newport News Marriott at City Center Pearl Salon II/III

2:00PM 2WB.00001 TMD and GPD Studies at HERMES. FRANK ELLINGHAUS, University of Colorado — In the last few years the HERMES experiment has taken dedicated data for studies of TMD-PDFs (Transverse Momentum Dependent Parton Distribution Functions) and GPDs (Generalized Parton Distributions). The data taken on a transversely polarized hydrogen target (2002-2005) allow, e.g., for studies of the Sivers and Collins mechanisms via measurements of azimuthal single-spin asymmetries in the semi-inclusive production of hadrons. A preliminary result for pions with much higher statistical significance than the published result and a measurement for kaons will be presented. In the last two years data was taken with a newly installed detector in the target region, which allows for the detection of the recoiling proton in exclusive processes used to study GPDs. While the analysis of this latest data set is ongoing, exclusive processes for earlier data sets have been identified using, e.g., missing mass techniques. Results from the exclusive production of pseudoscalar- and vector mesons and real photons (DVCS) will be shown, whereby especially in the case of DVCS various asymmetries on different targets and with respect to the beam spin, beam charge and longitudinal- and transverse target spin have been measured. Of particular interest are the asymmetries on the transversely polarized hydrogen target which led to a first attempt for a model dependent extraction of the orbital angular momentum of quarks in the nucleon.

2:35PM 2WB.00002 Experimental Studies at RHIC. BERND SURROW, BNL — This abstract not available.

3:10PM 2WB.00003 COFFEE BREAK —

3:30PM 2WB.00004 TMDs and GPDs at COMPASS. NICOLE D’HOSE, CEA-Scalay — This abstract not available.

4:05PM 2WB.00005 Generalized Parton Distributions on the Lattice. KOSNANTINOS ORGINOS, College of William and Mary, JLab — I review recent results on moments of Generalized Parton Distribution functions (GPDs) from Lattice QCD. In particular, I discuss the methodology of lattice calculations, and how various systematic errors arising in these calculations are controlled. I conclude with an overview of the roadmap towards precision non-perturbative determination of moments of GPDs, and discuss the potential impact to the extraction of GPDs form experiment.

4:40PM 2WB.00006 12 GeV Upgrade Jefferson Lab. VOLKER BURKERT, Jefferson Lab — I will discuss the program and opportunities to measure Generalized Partons Distributions (GPDs) at Jefferson Lab with the 12 GeV upgrade of the CEBAF accelerator. At the energy-doubled CEBAF the increased kinematics coverage will allow probing these new distributions functions in the entire valence quark regime. The experimental equipment planned for these measurements will be discussed as well.

Thursday, October 11, 2007 8:30AM - 12:16PM — Session AA Nuclear Theory: A Decade of Progress and Future Perspectives Newport News Marriott at City Center Grand Salon I/II

8:30AM AA.00001 Introduction. R. MILNER, Massachusetts Institute of Technology —

8:40AM AA.00002 Exploring the partonic structure of the nucleon. XIANGDON GJI, University of Maryland — The QCD structure of the basic building blocks of matter, protons and neutrons, is best described by partons – quarks and gluons – in the infinite momentum frame of the composite nucleons. While momentum distributions of partons can be studied through perturbative QCD processes, their spatial distributions have been probed through elastic form factors. A significant breakthrough in recent years has been the realization that partons can be probed in both spatial and momentum spaces simultaneously, resulting in tomographic pictures in quantum-phase space. In this talk, progress and prospects in establishing the partonic picture of the nucleon are discussed from both theoretical and experimental points of view. Discussions are also made about the origin of mass and the spin structure of the nucleon.

1Maryland Center for Fundamental Physics
9:16AM AA.00003 QCD in Extreme Conditions, MISHA STEPHANOV, University of Illinois at Chicago — Quantum Chromodynamics predicts that at some large temperature or density the strongly interacting matter transforms from the gas of observed hadrons into the plasma of quarks and gluons, ordinarily confined inside the hadrons. Since the inception of QCD the fundamental question of when and how this transformation is accomplished has been driving theoretical and then also experimental research. The phase diagram of QCD, the nature of the phases and the dynamics of QCD in the regime relevant to heavy ion collision experiments presents many challenges due to the nonperturbative character of QCD interactions. It is necessary to develop new theoretical ideas and tools to study these phenomena. I shall overview the past and present challenges such as the nature of the transition and of the critical point on the phase diagram, and how modern nuclear theory addresses them. I shall describe how recent experimental evidence points at a near-perfect fluidity of the matter created at RHIC, and how the theory meets the challenge of describing such a matter using time-tested techniques, such as numerical lattice calculations, as well as new analytical methods emerging from string theory.

9:52AM AA.00004 COFFEE BREAK —

10:28AM AA.00005 From Nuclei to Neutron Stars, SANJAY REDDY, Los Alamos National Laboratory — I will describe recent theoretical advances in nuclear structure and nuclear astrophysics that have been instrumental in unraveling the connections between nuclear physics and astrophysics. The role of nuclei, neutrino processes, and the states of matter at extreme density, in nucleosynthesis, supernova explosions and neutron star phenomena are not only known to be important, but we now understand specific correlations between the underlying nuclear physics and astrophysical observations. These developments are impacting and benefiting from both terrestrial nuclear experiments and astrophysical observations. I will discuss this interplay and explore how this synergy will help forge the path forward to develop a quantitative theory for dense systems, from nuclei to neutron stars. I highlight advances in describing strongly coupled many-body systems and discuss the emerging connections between nuclear structure, dense matter and cold-atom physics.

11:04AM AA.00006 Nuclear Theory and the New Standard Model, MICHAEL RAMSEY-MUSOLF, University of Wisconsin-Madison — During the next decade, a program of experimental studies of neutrinos and fundamental symmetries in nuclear physics is poised to uncover key ingredients of the “New Standard Model” of fundamental interactions. Nuclear theory will play a vital role in interpreting the results of this program and elucidating their implications for the New Standard Model. In this talk, I discuss some of the important challenges for nuclear theory in this context, focusing on neutrinoless double beta-decay, electric dipole moments, and precision measurements of neutrino properties and electroweak processes.

11:40AM AA.00007 Future directions for nuclear theory, DAVID KAPLAN, Institute for Nuclear Theory — Nuclear theory has reinvented itself over the past decade, creating new qualitative paradigms for matter under extreme conditions, while developing increasingly quantitative methods for determining the structure and interactions of hadrons in few- and many-body systems. The renaissance looks far from over, and with the advent of peta-scale computing, there will be opportunities for theorists to solve open questions in nuclear physics of ever greater complexity. I discuss some directions where progress in the near future looks particularly promising.

Thursday, October 11, 2007 2:00PM - 4:24PM —

Session BA Recent Results from Jefferson Lab Newport News Marriott at City Center Grand Salon I

2:00PM BA.00001 What’s the matter in the Proton?, ELIZABETH BEISE, University of Maryland — It has been over 70 years since the Nobel Prize was awarded to Otto Stern for the discovery that the proton has an anomalously large magnetic moment, nearly three times what one expects from a spin-1/2 object with no internal structure. This was one of the first hints of the spatial extent of protons and neutrons that make up nearly all of the visible matter in the universe. Not long after this discovery, this interior landscape began to be explored in detail through the use of electron scattering, a precision microscope with which one can peer deep inside the nucleon. Recent experiments, using polarized beams, light polarized targets, recoil detection and complementary views via the weak interaction are now changing our traditional textbook view of the nucleon and its lowest-lying excited states. This talk will be a review of the recent experimental results and a summary of near future opportunities.

2:36PM BA.00002 Correlations in Nuclei: Recent Progress on an Old Problem, ROCCO SCHIAVILLA, Old Dominion University/Jefferson Lab — The two preeminent features of the nucleon-nucleon (NN) interaction are its short-range repulsion and intermediate-long range tensor character. These induce strong spatial-spin-isospin NN correlations, which leave their imprint on the structure of ground- and excited-state wave functions. In the present talk I will review how these features influence a variety of nuclear properties—from energy spectra of low-lying states to two-nucleon density distributions to nuclear response functions—as well as the experimental evidence in support of their presence. In particular, I will show [R. Schiavilla, R.B. Wiringa, S.C. Pieper, and J. Carlson, Phys. Rev. Lett. 98, 132501 (2007)] how tensor correlations impact the momentum distribution of np pairs in the ground state of nuclei and make it order of magnitude larger than that of pp pairs for values of the relative momentum in the range (300–600) MeV/c and vanishing total momentum. This order-of-magnitude difference is seen in all nuclei considered, and has a universal character originating from the tensor components present in any realistic NN interaction. It should be easily observable in two-nucleon knock-out processes. Indeed, a preliminary analysis of (e,e’p) and (e,e’n) reactions in 12C finds [R. Subedi et al., in preparation] that the pp cross section is suppressed relative to the np by a factor \( \approx 10 \) in kinematics close to back-to-back emission of the two nucleons.

3:12PM BA.00003 A Decade of Structure Function Measurements at Jefferson Lab, KEITH GRIFFIOEN, College of William & Mary — With fine precision and extensive kinematic coverage, experimenters at Jefferson Lab have been measuring nucleon and nuclear structure functions, polarized and unpolarized, in the range of momentum transfer \( Q^2 \) from 10 to 100 GeV/c^2. These experiments have greatly increased our understanding of parton distributions, higher twists, duality, resonance excitations, non-perturbative QCDF, and nucleons in the nuclear medium. Our present ability to determine moments of structure functions makes direct comparisons to QCDF calculations and sum rules possible. I will present the state of our art.

3:48PM BA.00004 Excited Nucleon Resonance Properties from Lattice QCD, ADAM LICHTL, RIKEN BNL Research Center — We review the progress of the Lattice Hadron Physics Collaboration’s ongoing efforts to determine the tower of excited nucleon resonances as predicted by QCD. The most common approach to this problem is to consider two-point correlations of interpolating operators calculated using lattice QCD. We show that realistic interpolating operators are essential for accessing the states of interest and describe how such operators can be designed. We outline how a variant of the variational method combined with a systematic fitting approach can be used to extract finite-volume spectra from the Green’s functions, and illustrate the efficacy of the approach by showing preliminary results using two-flavors of dynamical fermions. We outline the connection between the finite-volume spectra obtained from the lattice and the continuum resonance states measured in experiment, and conclude with a discussion of current limitations and ongoing improvements.

This work is supported by the U.S. Department of Energy, Office of Nuclear Physics, under contract DE-AC05-06OR23177.

for the Lattice Hadron Physics Collaboration
Towards a Global QCD Analysis of Helicity-Dependent Parton Densities

Marco Stratmann, RIKEN — A solid understanding of the theoretical framework and its phenomenological inputs has been crucial for the success of perturbative QCD in the past and continues to be vital for ongoing and future nuclear and high-energy research programs. Taking single-inclusive hadron production as an example, I will briefly discuss recent progress in extracting fragmentation functions from data. Next, I will review the current status of spin-dependent parton densities and outline the steps towards a global QCD analysis.

Polarized-Inclusive DIS measurements at Jefferson Lab

Harut Avakian, Jefferson Lab, CLAS Collaboration — Longitudinally polarized electrons with energies of 4.2 and 5.7 GeV and longitudinally polarized proton and deuteron targets were used to measure the double spin asymmetries in semi-inclusive deep-inelastic scattering. Scattered electrons and electro-produced pions where detected in the CEBAF Large Acceptance Spectrometer at Jefferson Lab. The kinematic range covered is $0.3 < x < 0.7$, $Q^2 > 1$ GeV$^2$, $0.12 < y < 0.48$, $pt < 1$ GeV, and $0 < \phi^* < \pi$. From the double spin asymmetries, we will present the ratio of structure functions $g_1/F_1$ as a function of $x$, $pt$, and $\phi^*$, in each case averaged over the other kinematic variables due to limited statistical precision. Results will be presented for each of the three possible charge states of the detected pions. The results are sensitive to the spin-flavor structure of the nucleon, with the $p_1$ and $\phi^*$ dependence potentially providing access to the coupling of spin and orbital motion. Higher twist contributions may be significant at the low $Q^2$ values of the experiment, providing both a challenge and an opportunity for the interpretation of the data.

Di-Jet Cross Section and Longitudinal Double Spin Asymmetry Measurements with Event Kinematics Constraints in Polarized Proton-Proton Collisions at 200 GeV at STAR

Tai Sakuma, MIT, STAR Collaboration — The polarized gluon distribution in the proton, Delta G, is of particular interest to the STAR Spin program. While initial studies have focused on inclusive pion and jet analyses, recent improvements in RHIC luminosity and polarization enable di-jet analysis as the first correlation analysis to constrain initial event kinematics. With its large acceptance electromagnetic calorimetry and tracking system, STAR is well suited for these measurements. We report the status of the measurements of di-jet cross section at mid-rapidity for RHIC 2005 run and $A_{LL}$ within the pseudorapidity range from $-1$ to $+2$ for RHIC 2006 run.

Spin Structure of the Deuteron - New Results from CLAS

Nezvat Guler, Old Dominion University, Physics Department, CLAS Collaboration — The EG1B experiment, which was carried out at Jefferson Lab using the CLAS detector, measured double polarization asymmetries in the nucleon resonance region and above ($1.08 GeV < W < 3.0 GeV$). We used a longitudinally polarized electron beam of various energies incident on longitudinally polarized proton and deuteron targets. The large kinematic coverage of the experiment (0.05 GeV/c$^2 < Q^2 < 5.0 GeV/c^2$) will help us to understand the spin structure of the nucleon especially in the transition region between the hadronic degrees of freedom and the quark-gluon degrees of freedom. In this presentation new preliminary results on $A_1$ and $A_2$ for the deuteron will be shown.

Double Longitudinal Spin Asymmetry for Inclusive Hadron Production in 200 GeV Polarized p+p Collisions

Alan Hoffman, M.I.T — A primary goal of the STAR-spin program is the measurement of the gluon polarization (delta g) in the proton. The STAR detector, with its large-acceptance tracking and calorimetry, provides a uniquely suited environment for asymmetry measurements in a number of different final-state channels in polarized p+p collisions. These asymmetries will provide significant contributions to a global analysis of delta g. We present here the most recent measurements of the double longitudinal spin asymmetries ($A_{LL}$) for the inclusive production of both neutral and charged pions at mid-rapidity. These asymmetries are compared to NLO pQCD calculations for different polarization scenarios and are used to provide constraints on delta g. Charged pions are of particular interest as they are sensitive to the sign of delta g. Results and continuing analyses are presented from RHIC runs 5 and 6.

Accessing the Gluon Polarization in the Proton through the Measurement of the Double Helicity Asymmetry in Neutral Pion Production in Polarized Proton Collisions at PHENIX

Kieran Boyle, Stony Brook University, PHENIX Collaboration — A primary goal of the RHIC Spin program is to measure the gluon spin contribution ($\Delta G$) to the spin of the proton through the measurement of double helicity asymmetries ($A_{LL}$) in polarized proton collisions. Pions are abundantly produced in polarized-proton collisions and so are a good candidate for a high statistics analysis. The PHENIX EMCaL has good energy resolution and high granularity which, when used with a high energy photon trigger, yield a substantial $\pi^0$ sample over a wide range in transverse momentum ($p_T$). The 2005 and 2006 polarized proton runs ($\sqrt{s} = 200$ GeV) saw large increases in luminosity ($L$) and polarization ($P$) compared to previous runs, resulting in a high figure of merit ($P^4 L$). $\pi^0 A_{LL}$ from 2005 and 2006 are precise enough to be sensitive to $\Delta G$. Results from 2005 and 2006 for $\pi^0 A_{LL}$ at mid rapidity will be shown.

Constraints on Gluon Polarization in the Proton from PHENIX Double Helicity Asymmetry Data

Alexander Bazilevsky, Brookhaven National Laboratory, PHENIX Collaboration — PHENIX experiment at RHIC has collected significant amount of data on longitudinal double spin asymmetry ($A_{LL}$) for different particle production in polarized proton collisions, which is sensitive to the gluon polarization ($\Delta G$) in the proton. We discuss a simple approach to constrain $\Delta G$ from PHENIX $\pi^0 A_{LL}$ data through the comparison with NLO pQCD calculations that incorporate a model of gluon polarization. Limitations of this approach as well as an opportunity to include other channels will be discussed.

Inclusive $\pi^0$ Production in Polarized pp Collisions using the STAR Endcap Calorimeter

Jason Webb, Valparaiso University, STAR Collaboration — The two-spin helicity asymmetry for inclusive $\pi^0$ production in polarized pp collisions can provide constraints on the gluon contribution to the spin of the proton with sensitivity comparable to that attainable with full jet reconstruction [1]. In 2006, the STAR experiment accumulated $\approx 100 pb^{-1}$ of data with beams longitudinally polarized ($P \approx 60\%$) at the Relativistic Heavy Ion Collider. Measurements of $A_{LL}(\pi^0)$ in the range $1 < \eta < 2$ provide information about a different mix of partonic subprocesses and are subject to different experimental uncertainties than mid-rapidity jet measurements, providing an important cross check. Status of the analysis of $A_{LL}(\pi^0)$ measured using the STAR Endcap Calorimeter [2] is discussed.

References:


4:00PM BB.00009 Neutral Pion Longitudinal Double Spin Asymmetry Measurement at Forward Rapidity with the PHENIX Muon Piston Calorimeter, Aaron Veicht, UIUC, PHENIX Collaboration — The PHENIX experiment at RHIC commissioned a new forward calorimeter during the 2006 polarized proton run, the Muon Piston Calorimeter (MPC). The MPC is a PbWO4 based electromagnetic calorimeter covering $3.1 < |y| < 3.7$ in pseudo rapidity and $2\pi$ in azimuthal angle. One of the main goals of the PHENIX experiment is to contribute to solving the “proton spin crisis” by determining the gluon spin contribution to the proton’s total spin. This can be done through measurements of the longitudinal double spin asymmetry ($A_{LL}$). Neutral pions produced at the rapidity of the MPC extend the momentum fraction $x$ of the proton sampled, allowing for a measurement of the $n^0 A_{LL}$ in a previously unexplored kinematic region at the PHENIX experiment — a region where quark-gluon interactions dominate so that the sign of the gluon helicity can be directly measured in $A_{LL}$. In this talk I will present the status from the analysis of the neutral pion $A_{LL}$ using the 2006 $\sqrt{s} = 62$ GeV data.

4:12PM BB.00010 Constraints on $\Delta G$ through Longitudinal Double Spin Asymmetry Measurements of Inclusive Jet Production in Polarized $p+p$ Collisions at 200 GeV, Murad Sarsour, Texas A&M University, STAR Collaboration — The STAR experiment at the Relativistic Heavy Ion Collider at Brookhaven National Laboratory uses polarized $p$ collisions at a center of mass energy of $\sqrt{s} = 200$ GeV to determine the polarized gluon distribution in the proton via spin asymmetry measurements. The inclusive jet channel is particularly robust due to its large cross-sections and relative independence from fragmentation functions. Data were collected during 2006, at sampled luminosity of $\sim 6$ pb $^{-1}$, with 60% beam polarization. We present run 2006 analysis progress for the double longitudinal spin asymmetry for inclusive jet production at mid-rapidity, along with results from run 2005. Comparisons to theoretical calculations using deep-inelastic scattering parameterization and the non-linear path that brought me here.

4:24PM BB.00011 Longitudinal Double Spin Asymmetries of Di-Hadron Production at PHENIX in $p$ Collisions at $\sqrt{s} = 200$ GeV, John Koster, University of Illinois, Urbana Champaign, PHENIX Collaboration — The PHENIX detector, located at Brookhaven National Laboratory’s Relativistic Heavy Ion Collider, measures longitudinal double spin asymmetries ($A_{LL}$) with the goal to determine the gluon spin contribution to the proton spin. The current suite of measurements at RHIC rely on inclusive jet or inclusive hadron kinematics and are successfully determining the gluon spin contribution at moderate values of Bjorken $x$. Historically, low $x$ contributions were critical in the measurement of the quark spin contribution. This talk will present the current status of a di-hadron measurement which exploits the kinematics of asymmetric collisons to probe gluons at low $x$. The measurement selects events with two neutral pions, one at mid-rapidity and the second at forward rapidity. A new PHENIX electromagnetic calorimeter and the existing calorimetry at mid-rapidity make this measurement possible.

4:36PM BB.00012 Parameterization of the eta fragmentation functions from world $e^+e^-$ and $p+p$ data, Christine Aidala, University of Massachusetts Amherst, Joseph Seele, University of Colorado, Boulder, Marco Stratmann, Riken, Werner Vogelsang, Brookhaven National Laboratory — Despite the relatively large production cross section of the eta meson and the facility with which it can be detected and identified experimentally, as yet no parameterization of the eta fragmentation functions has been made available in the literature. The present work seeks to parameterize the eta fragmentation functions using world data from $e^+e^-$ as well as proton-proton collisions. The data and methods used and the current status will be discussed.

Thursday, October 11, 2007 2:00PM - 4:42PM — Session BC Mini-Symposium on the CEU 10th Anniversary Newport News Marriott at City Center Pearl Salon I

2:00PM BC.00001 A Research Journey from Then to Now: Investigation of $^{100,101}$Pd, D.A. Meyer, Rhodes College — Structural evolution is traditionally described as a function of nucleon number. Instead, changes in structure as a function of angular momentum can be identified using the E-Gamma Over Spin (E-GOS) method. Excited states in $^{100,101}$Pd were populated in an experiment performed at the Wright Nuclear Structure Laboratory at Yale University following the reaction $^{12}$C + $^{92}$Zr $\rightarrow^{100,101}$Pd + $\gamma$. Data were collected at four beam energies: 66 MeV, 68 MeV, 70 MeV, and 75 MeV. Eight HPGe detectors in the SPEEDY array detected gamma ray decay from high spin states. I will interpret results within the E-GOS framework discuss the impact of the CEU program on my own research path. This work has been supported by U.S. DOE under grant number DE-FG02-91ER40609.

2:36PM BC.00002 Discovering the Questions and Challenges of Neutrino Physics, Noah Oblath, University of Washington — Participation in the CEU program exposes undergraduate students to the wide variety of fascinating questions being asked and studied in the field of nuclear physics. As an undergraduate I attended three consecutive DNP Fall Meetings through the CEU program, presenting the research I performed during three summers working on the Sudbury Neutrino Observatory (SNO). The opportunities to present my research and hear talks by other people in the field inspired me to continue in neutrino research, working on the same experiment, as a graduate student. I loved learning about the fundamental questions SNO was trying to answer, as well as the day-to-day aspects of the research. Continuing to work on the SNO, I have had the opportunity to work on a wide variety of projects, including detailed Monte Carlo simulations of the Neutral-Current Detection Array data. I have enjoyed the challenges of analyzing the latest solar neutrino data, and the subtleties involved in reaching the few-percent level of accuracy in neutrino experiments.

2:54PM BC.00003 From a CEU ’98er: 9 years and 5 research projects later, Christine Aidala, UMass Amherst — Since my first research experience in 1996 working in low-energy nuclear structure, the results of which were presented at the original DNP CEU poster session in Santa Fe in 1998, subsequent projects led me to weave my way through various energies and collision systems in nuclear and particle physics. Through the course of the broad exposure to research that I have been fortunate enough to experience, I have found a niche for myself in the study of nucleon spin structure. I originally got involved in the field in 1998-99 through my undergraduate senior project on studies for polarizing the proton beam at HERA in Hamburg, Germany. After a foray into particle physics followed by an unanticipated diversion from research, teaching music and English abroad, fate—and some kind individuals—would give me the opportunity to return both to physics and specifically to nucleon structure in 2001 as part of the PHENIX experiment at the Relativistic Heavy Ion Collider. Six years into my research on proton spin structure as a member of the PHENIX Collaboration, I will discuss where I am today and the non-linear path that brought me here.
3:12PM BC.00004 The $^{17}$O($p,\alpha$)$^{14}$N reaction measured using a novel technique. B.H. MOAZEN, Univ. of Tenn, J.C. BLACKMON, D.W. BARDAYAN, ORNL, K.Y. CHAE, Univ. of Tenn, K. CHIPP, CO School of Mines, C.P. DOMIZIOLI, Tenn. Tech, Univ. R. FITZGERALD, UNC, U. GREIFF, CO School of Mines, W.R. HIX, ORNL, K.L. JONES, Univ. of Tenn., R.L. KOUZ, Tenn. Tech, Univ., E.J. LINGERFELT, Univ. of Tenn, R.J. LIVESAY, CO School of Mines, C.D. NESARAJA, ORNL, S.D. PAIN, Rutgers, L.F. ROBERTS, ORNL, J.F. SHRINER JR., Tenn. Tech Univ., M.S. SMITH, ORNL, J.S. THOMAS, Rutgers — We developed a new approach for measuring ($p,\alpha$) reactions and applied it to measure the energy and strength of the 183 keV resonance in $^{17}$O($p,\alpha$)$^{14}$N that was recently reported to significantly increase the reaction rate in novae. A beam of $^{17}$O from the Oakfield Radioactive Ion Beam Facility [TUNL] tandem accelerator bombarded hydrogen gas, which filled a differentially pumped scattering chamber at pressures up to 4 Torr. Reaction products were detected in coincidence and the vertex of the reaction was determined from the relative kinematics of the two products. Nova simulations show the new $^{17}$O($p,\alpha$)$^{14}$N reaction rate significantly decreases $^{15}$F production in low mass ONeMg nova but affects more energetic novae less. Results and astrophysical implications will be presented as well as comments regarding my past CEU participation. ORNL is managed by UT-Battelle for the US DOE.

3:30PM BC.00005 The study of $^{158}$Gd from CEU to Present. S.R. LESHNER, Lawrence Livermore National Laboratory — The identification of 13 $^+$ states by the $^{160}$Gd($p,\gamma$)$^{158}$Gd reaction was presented as a poster at the 1998 CEU session. Since this identification, a subsequent $^{158}$Gd(n,$\gamma$) experiment was performed at the University of Kentucky and $\gamma$ rays associated with these levels were assigned. These assignments allowed lifetimes of many levels of varying spins to be determined and transition probabilities to be calculated. Follow one nucleus and one CEU student through a survey of the experimental results to the most current interpretations of the vibrational structure of the deformed $^{158}$Gd.

3:48PM BC.00006 New mass measurements of neutron rich nuclides at the NSCL. A. ESTADE, MILAN MATOS, MATTES HARTLE, CO State University and Joint Institute for Nuclear Astrophysics, DANIEL BAZIN, NSCL, Michigan State University. ANA BERCERRIL, THOM ELLIOT, NSCL, Michigan State University and Joint Institute for Nuclear Astrophysics, ALEXANDRA GADE, NSCL, Michigan State University, DANIEL GALAVIZ, GIUSEPPE LORUSSO, JORGE PEREIRA, NSCL, Michigan State University and Joint Institute for Nuclear Astrophysics, MAURICIO PORTILLO, NSCL, Michigan State University, ANDREW ROGERS, HENDRIK SCHATZ, NSCL, Michigan State University and Joint Institute for Nuclear Astrophysics, ANDREAS STOLZ, NSCL, Michigan State University, MARK WALLACE, Los Alamos National Laboratory — A mass measurement of exotic isotopes in the region of 68Fe has been performed at the NSCL using the time-of-flight technique recently established. Experimental knowledge of the mass of very neutron rich neutron nuclei is an important input for astrophysical applications, such as nucleosynthesis during the r-process and the evolution of matter in the crust of an accreting neutron star, where present calculations are mostly limited to using theoretical mass extrapolations. We present the details of the experimental set up, as well as preliminary results.

4:06PM BC.00007 Double-Beta Decay at TUNL. MARY KIDD, TUNL - Duke University — Studying double-beta decay at Triangle Universities Nuclear Laboratory (TUNL) is perhaps one of the most promising ways to pinpoint the neutrino mass. What they do not mention is that to study double-beta decay, you probably have to become a certified miner, and if you have a fear of goats, you should stay away. In this talk, I will tell you some of my experiences as a TUNL graduate student, and how I am now nearly qualified for a job in the mining industry.

4:24PM BC.00008 Selective Suppression of Sulfur by Photodetachment in a RF Quadrupole Ion Cooler. T. LEWIS, Department of Physics and Astronomy, The University of Tennessee, ALFREDO GALINDO-URIBARRI, CHARLES HAVENER, YUAN LIU, Physics Division, Oak Ridge National Laboratory — A method for selectively suppressing contaminants in negative ion beams through collisional cooling and photodetachment has been developed at the Holifield Radioactive Ion Beam Facility. Due to possible applications in Accelerator Mass Spectrometry, the potential for purifying a $^{36}$Cl beam of $^{36}$S contamination using this method was explored using stable S- and Cl- ions and a pulsed Nd:YLF laser at 527 nm. The laser's photon energy (2.352 eV) is above sulfur's electron affinity (2.077 eV) and below chlorine's (3.617 eV), allowing selective suppression of sulfur by photodetachment. Results and astrophysical implications will be presented as well as comments regarding my past CEU participation. ORNL is managed by UT-Battelle for the US DOE.

Thursday, October 11, 2007 2:00PM - 4:36PM – Session BD Ultra Relativistic Heavy Ion Collisions I

2:00PM BD.00001 Initial Energy Density, Momentum and Flow in Heavy Ion Collisions. RAINER FRIES, Texas A&M University & Riken BNL, JOSEPH KAPUSTA, University of Minnesota, YANG LI, Iowa State University — The very early phase of the collision of large nuclei at high energies is described by the color glass condensate. We compute the energy and momentum densities of the gluon field in a classical approximation at the earliest stage of the collision. We also present constraints for the initial energy density, pressure and flow in the subsequent plasma phase. Phenomenological consequences for RHIC and LHC are discussed.

2:12PM BD.00002 Transport Coefficients of Hadronic Matter. NASSER DEMIR, STEFFEN A. BASS, Duke University — Ultra-relativistic heavy-ion collisions at RHIC are thought to have created a Quark-Gluon-Plasma (QGP) with a very low shear viscosity in the deconfined phase. However, as the QGP hadronizes it will evolve through a hadronic phase with rapidly increasing viscosity. In order to fully characterize the QGP state, one has to separately determine the viscosity of the hadronic phase. We present a calculation of transport coefficients such as the shear viscosity, thermal conductivity, and the diffusion coefficient as a function of $T$ and $\mu_B$ for nuclear densities in the range ($\mu_B - 2\mu_B$). The hadronic medium is simulated using the Ultrarelativistic Quantum Molecular Dynamics (URQMD) model in a box with periodic boundary conditions. Green-Kubo theory enables us to compute linear transport coefficients of such a medium by examining near-equilibrium fluctuations. We outline a scheme combining the Green-Kubo formalism and our microscopic transport model to extract the time-dependence of the shear viscosity of the matter created in an ultrarelativistic heavy ion collision.

2:24PM BD.00003 Produced Hadron Spectra in $p + p$ Collisions at $\sqrt{s} = 200$ GeV. K. HAGEL, Cyclotron Institute, Texas A&M University, BRAHMS COLLABORATION — The rapidity dependence of particle production in high energy $p + p$ collisions can provide important information of parton distribution functions and the transport of baryon number. In addition, $p + p$ collisions provide an elementary reference for heavy ion collisions. Identified charged hadron spectra resulting from $p + p$ collisions at RHIC have been measured over a wide range of rapidity with BRAHMS for $\sqrt{s} = 200$ GeV. We will present the spectra of positive and negative $\pi$ and $p$. The spectra are analyzed to extract rapidity densities over the rapidity range from 0 to near 4 which we compare to rapidity distributions of the same species of produced hadrons in Au + Au collisions at the same energy. The proton rapidity densities are used to determine nuclear stopping while the pion yields constrain the total entropy production.
2:36PM BD.00004 High-pT pion and proton yields in p+p collisions at sqrt(s)=200GeV.
YICHUN XU, LIJUAN RUAN, STAR COLLABORATION — Identified hadrons (pions, protons, and anti-protons) in mid-rapidity at high transverse momentum (pT∼10GeV/c) can be used to test the validity of pQCD in p+p collisions. They also provide a baseline for the study of color charge effect of parton loss in heavy ion collisions. However, with current event statistics from minimum-bias triggered p+p collisions the proton-anti-proton spectra are limited to pT<17GeV/c. We report a study of charged hadron production in events triggered by high deposit energy in electromagnetic calorimeter positioned at mid-rapidity. Preliminary results on particle ratios and their pT dependence up to pT∼12GeV/c will be presented. The effect of the above trigger can lead to relative enhancement/suppression of one of the sub-process (qq, eg, gg) of jet production, these aspects will also be discussed.

2:48PM BD.00005 Measurements of the dilepton continuum in p+p collisions at the PHENIX experiment at RHIC . TOSTEN DAHMS, Stony Brook University, PHENIX COLLABORATION — Among other penetrating probes, electro-magnetic probes are ideal tools to investigate the full time evolution and dynamics of the hot and dense matter produced in high energy heavy ion collisions, as they undergo no interaction in the final state. In the dilepton continuum Dalitz decays of light hadrons and direct decays of vector mesons, which might be modified in the medium, add to hard processes, such as correlated charm production and to direct thermal photons, emitted as a blackbody radiation from the plasma. PHENIX has measured the dielectron continuum in heavy ion reactions at \( \sqrt{s_{NN}} = 200 \) GeV. Compared to peripheral collisions, which agree well to the cocktail of known hadronic sources, with more central collisions show indications of an enhanced yield in the low mass region. The intermediate mass region on the other hand hints at a suppression of the yield increasing with centrality which adds additional information to the charm medium modifications. A measurement of p+p reactions is crucial to provide a baseline reference necessary to interpret the signals in heavy ion collisions. The results of this analysis will be presented and compared to the results from heavy ion collisions.

3:00PM BD.00006 Dielectron Mass Spectra From \( \sqrt{s_{NN}} = 200 \) GeV Heavy Ion Collisions at PHENIX , SARAH CAMPBELL, SUNYSB, PHENIX COLLABORATION — The dielectron mass spectra is rich in physics signals including vector meson decays, hadron Dalitz decays, correlated semi-leptonic heavy flavor decays and direct virtual photon emission. In medium mass modifications of light vector mesons due to the QCD phase transition, the effects of chiral symmetry restoration as well as thermal radiation, may result in an additional signal in the low mass region. The PHENIX \( \sqrt{s_{NN}} = 200 \) GeV Au+Au analysis shows the following centrality dependent trends: an excess in the the low mass region of the central Au+Au spectra over the expected reference cocktail of known hadronic sources, and a suppression pattern in the intermediate region, where correlated charm is expected to dominate. The status of the PHENIX \( \sqrt{s_{NN}} = 200 \) GeV Cu+Cu analysis, in minimum bias and separated into centrality classes, will be presented. The Cu+Cu dataset will provide additional sensitivity in the study of centrality dependent trends. Comparisons between the Au+Au, Cu+Cu and p+p spectra with N_{coll} and N_{part} scaling will clarify the nature of the many features seen in the Au+Au spectra.

3:12PM BD.00007 Chemical freeze-out in heavy-ion collisions and the quark-hadron phase transition , GREGORY KESTIN, ULRICH HEINZ, The Ohio State University — Using the ideal hydrodynamic model we show that in heavy-ion collisions there exists a fundamental difference between “chemical” and “kinetic” freeze-out. This difference is exposed by showing that the “chemical decoupling temperature,” found experimentally to have no dependence on impact parameter, cannot be reproduced in simulations using a kinetic decoupling criterion. The “kinetic freeze-out temperature,” on the other hand, which is found to have impact parameter dependence, can be described quantitatively using such simulations. We show that kinetic decoupling necessarily leads to impact parameter dependence of the decoupling temperature. Chemical decoupling in heavy-ion collisions must therefore be controlled by a non-kinetic process, such as a phase transition. This supports the interpretation of the measured universal chemical decoupling temperature as the critical temperature for the quark-hadron phase transition.

This work supported by DOE grant DE-FG02-01ER41190 and NSF REU grant PHY-0354916

3:24PM BD.00008 System Size Dependence of \( \phi \)-meson Production at RHIC, XINGHUA SHI, STAR COLLABORATION — The results on \( \phi \)-meson production in Au+Au collisions and comparison to model calculation indicate that the \( \phi \) mesons are produced by coalescence of thermalized s-quarks in central collisions. The observation of \( \phi \)-meson elliptic flow in non-central collisions and its magnitude at intermediate p_T being similar to other mesons has been considered as a clear signature of partonic collectivity at RHIC [1]. The Cu+Cu collisions provide a tool to probe the system size dependence of the \( \phi \)-meson production and collision dynamics at RHIC. In this talk we will present the STAR preliminary results on the \( \phi \)-meson production in Cu+Cu collisions at both 62.4 and 200 GeV from the STAR Collaboration. The transverse mass spectra, particle ratios, the strangeness enhancement and elliptic flow of \( \phi \)-mesons will be compared with the results from the Au+Au collisions at same beam energy in order to understand the system size dependence of \( \phi \)-meson production in high-energy collisions at RHIC.

3:36PM BD.00009 Production of the \( \phi \) mesons at intermediate rapidity in Au+Au collisions at \( \sqrt{s_{NN}} = 200 \) GeV, DIPALI PAL, University of Kansas, BRAHMS COLLABORATION — Study of the \( \phi \) mesons produced in relativistic heavy-ion collisions can unfold properties of the hot and dense quark gluon matter produced in these reactions. Since the \( \phi \) is a bound state of s and \( \bar{s} \) quarks it is not subject to the canonical suppression of strangeness in p+p interactions and thus serves as a clean probe of strangeness enhancement in Au+Au collisions. The measurement of the \( \phi \)-meson spectra, yield, and temperature parameter gives information on strangeness enhancement and the bulk properties of the partonic matter. The BRAHMS experiment at RHIC has measured particles produced in high luminosity Au+Au collisions at \( \sqrt{s_{NN}} = 200 \) GeV over a broad range of rapidity and p_T. Using the efficient tracking system and high resolution time of flight wall of the mid-rapidity spectrometer (MRS), we have measured the \( \phi \) mesons in the \( K^+ K^- \) decay channel at \( y \sim 1 \). The first results of the \( \phi \rightarrow K^+ K^- \) measurements with focus on spectra and yield analysis will be presented.

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

3:48PM BD.00010 Thermodynamics of 2+1 flavor QCD at small quark masses, PETER PETRECZKY, BNL — I am going to present new results in 2+1 flavor lattice QCD simulations at finite temperature at small quark masses from RBC-Bielefeld Collaboration. The strange quark mass was fixed to its physical value, while light quark masses corresponding to pion mass of 200MeV was used. Calculations of the equation of state of strongly interacting matter, fluctuations of conserved charges and free energy of static quark anti-quark pair will be discussed.

4:00PM BD.00011 Gluon recombination in high parton density QCD: inclusive \( \pi \)-meson production, YANG LI, Iowa State University, KIRILL TUCHIN, Iowa State Univ & RIKEN/BNL Research Center — We argue that the collinear factorization of the fragmentation amplitudes for high energy densities \( \rho \leq Q_0/g \) due to high parton densities in colliding hadrons and/or nuclei. We calculate, at next-to-leading order in projectile parton density and to all orders in target parton density, the double-inclusive cross section for production of a pair of gluons in the scalar \( J = 0^+ \) channel. Using the low energy theorems of QCD we find the inclusive cross section for \( \pi \)-mesons production.
4:12PM BD.00012 Measurement of direct photons with a new $\pi^0$ tagging method in $\sqrt{s_{NN}} = 200\text{GeV}$ AuAu Collision at PHENIX, HAIJIANG GONG, State Univ. of New York at Stony Brook, PHENIX COLLABORATION — Direct photons provide a excellent probe to study the different stages of a heavy ion collision, especially the formation of a quark-gluon plasma (QGP), without being influenced by the strong interaction and hadronization processes. In the $p_T$ range of 1-3 GeV/c thermal photons are expected to be the dominant source of direct photons and carry information about initial temperature of QGP. The yield of direct photons can be determined based on the inclusive photon yield and the background from hadronic decays. But due to the huge hadronic background at low $p_T$, the measurement is very challenging. A new method to determine direct photon excess yield above the background from decay photons is presented, which should lead to smaller systematic errors at low $p_T$. It uses strict photon identification in the EMCAL and a charged particle veto to extract a clean photon signal. The clean photons are then tagged with EMCAL photon candidates, which can be reconstructed with high efficiency, to determine the fraction of photons originating from $\pi^0$ decays. Many systematic uncertainties and detector effects cancel in this method. The result of this analysis and comparison with several other thermal photons measurements at PHENIX will be presented.

4:24PM BD.00013 Separation of different collision orientations in relativistic heavy ion reactions between deformed nuclei — CHANDRA NEPALI, GEORGE FAI, DECLAN KEANE, Kent State University — In relativistic uranium-uranium collisions, there is the potential to produce more extreme conditions of excited matter than is possible using spherical nuclei like gold or lead at the same incident energy. However, this potential is partly lost if it is not possible to distinguish experimentally between different collision orientations when the ions interact near zero impact parameter. Of special interest are the “tip-tip” orientation in which the long axes of both deformed nuclei are aligned with the beam axis, and the body-body orientation in which the long axes are both perpendicular to the beam axis and parallel to each other. In this talk, we report results of model simulations in which a promising level of discrimination can be achieved using a variety of experimental observables.

Thursday, October 11, 2007 2:00PM - 4:00PM
Session BE Nuclear Astrophysics I Newport News Marriott at City Center Grand Salon V

2:00PM BE.00001 Core Collapse Supernovae and the r-Process: An Amalgam of Current Ideas, MATTHEW MEIXNER, GRANT MATHEWS, University of Notre Dame, JAMES WILSON, Lawrence Livermore National Laboratory, KAORI OTSU, University of Chicago — After several decades of research the sites for the rapid neutron capture process (i.e. the r-process) have not been unequivocally identified. However, it is generally agreed upon that the most likely candidates are type II supernovae. We will be using a renovated r-process collapse supernova simulation that utilizes full general relativity and runs out to late times. In this talk we will discuss using this simulation in conjunction with the latest r-process nuclear abundance calculations. We will address the critical role played by the neutrino-energized high entropy bubble in the nucleosynthesis of heavy nuclei.

2:12PM BE.00002 Neutrinos, Fission Cycling, and the r-process, JOSHUA BEUN, GAIL MCLAUGHLIN, North Carolina State University, REBECCA SURMAN, Union College, RAPH HIX, Oak Ridge National Laboratory — Recent halo star abundance observations exhibit the presence of a consistent r-process pattern between the second, $A \approx 130$, and third, $A \approx 195$, peaks. This universal pattern is known as the “main” r-process. Using the neutrino-driven wind of the core-collapse supernova as our guide, we explore fission cycling and steady-$\beta$ flow as the driving mechanisms behind production of this “main” r-process. These mechanisms robustly produce the general structure of the “main” r-process. In the core-collapse supernova environment, neutrinos play an important role as they facilitate the explosion mechanism and influence the elemental composition of the outflow. As conditions must be more neutron-rich than current wind models predict for both fission cycling and steady-$\beta$ flow to occur, we examine wind environments under a variety of neutrino luminosities and effective temperatures. We find a reduction in the electron neutrino luminosity is necessary to allow for both fission cycling and steady-$\beta$ flow. This reduction may result from active-sterile neutrino oscillations or other new physics.

2:24PM BE.00003 Big Bang Nucleosynthesis of $^6\text{Li}$ and $^7\text{Li}$, GRANT MATHEWS, UND, MOTOHICO KUSAKABE, TOSHIKATSU KAJINO, TAKAHASHI YOSHIDA, NAOI, RICHARD BOYD, LLNL — The $^6\text{Li}$ abundance observed in metal poor halo stars exhibits a plateau similar to that for $^7\text{Li}$ suggesting a primordial origin. However, the observed abundance of $^6\text{Li}$ is a factor of $10^3$ larger and that of $^7\text{Li}$ is a factor of 3 lower than the abundances predicted in the standard big bang when the baryon-to-photon ratio is fixed by WMAP. Here we show that both of these abundance anomalies can be explained by the presence of a long-lived massive, negatively-charged leptonic particle during nucleosynthesis. Such particles would capture onto the newly synthesized nuclei thereby reducing the reaction Coulomb barriers and opening new transfer nuclear reaction possibilities, which catalyze a second round of big bang nucleosynthesis. This novel solution to both of the Li problems can be achieved with or without the additional effects of stellar destruction.

2:36PM BE.00004 Helium Burning Reaction Rate Uncertainties and Consequences for Supernovae, C. TUR, NSCL/MSU, A. HEGER, LANL/UCSC, S.M. AUSTIN, NSCL/MSU, and JINA — The triple alpha and $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$ reaction rates determine the carbon to oxygen ratio at the completion of core helium burning in stars, which, in turn, influences the later stellar burning stages. We explored the dependence of massive star evolution and nucleosynthesis yields on the experimental uncertainties in the triple alpha rate (10 to 12%) and the $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$ rate (25 to 35%) using full stellar models followed to core collapse and including supernova explosion. The production factors of medium-weight elements obtained by using the Lodders (2003) solar abundances for the initial star composition, rather than the abundances of Anders & Grevesse (1989), provide a less stringent constraint on the $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$ rate. Variations within the current uncertainties in both reaction rates, however, induce significant changes in the central carbon abundance at core carbon ignition and in the mass of the supernova remnant. An experiment is being carried out by an NSCL/WMU collaboration to improve the accuracy of the triple alpha reaction rate.

2:48PM BE.00005 Maxwellian-averaged cross sections and astrophysical reaction rates from ENDF/B-VII.0, JEFF-3.1, JENDL-3.3 and ENDF/B-VI.8 evaluated nuclear reaction data libraries, BORIS PRITYCHENKO, ALEJANDRO A. SONZOGNI, SAID F. MUGHABGHAB, National Nuclear Data Center, Brookhaven National Laboratory — Maxwellian-averaged cross sections and astrophysical reaction rates were calculated for $(n,\gamma)$, $(n,p)$, $(n,f)$, $(n,\alpha)$, $(n,2n)$ and $(n, t-2n)$ reactions from ENDF/B-VII.0, JEFF-3.1, JENDL-3.3 and ENDF/B-VI.8 evaluated nuclear reaction data libraries. Four major nuclear reaction libraries were processed under the same conditions for temperatures (kT) range from 1 keV to 1 MeV. Present results provide a set of independent benchmarks and complimentary nuclear data sets for the KADONIS nuclear astrophysics database that is currently under development. Current calculation of s-process nucleosynthesis nuclei is compared with previous data sets. Possible physics implications and differences between data sets are discussed.
3:00PM BE.00006 A precision measurement of the $^3$He($\alpha,\gamma$)$^7$Be astrophysical S-factor. T.A.D. BROWN, K.A. SNOVER, D.W. STORM, C. BORDEANU, D. MELCONIAN, A.L. SALLASKA, S.K.L. SJUE, S. TRIAMBK, A.M. CRISP, J.D. LOWREY, K. MICHNICKI, P. PEPLOWSKI, J. SIBILLE, University of Washington — The $^3$He($\alpha,\gamma$)$^7$Be reaction is the gateway to the p and p+p* branches, providing the principle route to energeto neutrino production in the Sun. The uncertainty on the accepted value of S(0) for this reaction is currently the largest important nuclear physics uncertainty (+/- 10%) in the Solar Model [1]. A more precise value of S$_{34}$(0) would bring an improvement in solar neutrino flux calculations, and in predictions of $^7$Li production in Big-Bang Nucleosynthesis which are currently significantly higher than observed $^6$Li abundances [2]. Precision measurements of S$_{34}$(E) have been made at eight different energies between $E_{CM} = 329$ and 1235 keV, using the terminal ion source on the Van-de-Graaff accelerator at the University of Washington. The prompt gamma-ray yield and the $^7$Be activity have been measured at each energy in the same irradiation, permitting two different methods for determining S$_{34}$(E). This presentation discusses the experimental details of these measurements, the analysis of the data and our results for S$_{34}$(0).


3:12PM BE.00007 Determination of the astrophysical S-factor for the $^{12}\text{N}(p,\gamma)^{13}\text{O}$ reaction from $^{12}$N,$^{13}$O proton transfer reaction, A. BANU, T. AL-ABDULLAH, C. FU, C.A. GAGLIARDI, Y. LI, M. MCCLESKEY, G. TABACARU, L. TRACHE, R.E. TRIBBLE, Y. ZHAI, Cyclotron Institute, Texas A&M University, College Station, TX 77843, V. BURJAN, Institute of Nuclear Physics, Czech Academy of Sciences, Prague, Czech Republic, F. CARSTOIJ, IFIN-HH, Bucharest, Romania — The reaction rate for the radiative proton capture on the drip line nucleus $^{13}$N was determined using the indirect Asymptotic Normalization Coefficient (ANC) method. This reaction is important for studying the nucleosynthesis in Population III stars with low-metallicity. A 23 MeV/nucleon $^{12}$C primary beam from the K500 cyclotron at Texas A&M University was employed. Secondary $^{12}$N beam of 2 x $10^6$ pps was separated using the recoil spectrometer MARS. The $^{14}$N($^{12}$N,$^{13}$O)$^{14}$C proton transfer reaction at 12 MeV/nucleon was measured to extract the ANC for the virtual decay $^{13}$O$ightarrow$^{12}N + p. The ANC was then used to determine the direct component of the astrophysical S-factor. The results of this measurement will be discussed.

3:24PM BE.00008 New measurement of $\Gamma_e/\Gamma$ for the $0^+\to 7.65\text{MeV}$ state in $^{12}$C, N.J. GOODMAN, J. BOS, J.C. LIGHTHALL, S.T. MARLEY, J. SNYDER, A.H. WUOSSMAA, Western Michigan University, C. TUR, SAM M. AUSTIN, E. ESTRADA, G. LORUSSO, Michigan State University and Joint Institute for Nuclear Astrophysics — The rate of $^{12}$C formation through the well known “triple- alpha” process is determined by the radiative partial width of the excited $0^+$ state at 7.65 MeV in $^{12}$C. Experimentally, the uncertainty in this quantity is determined from the radiative branching ratio, the partial width for $e^+e^-$ decay, and the pair branching ratio. The current uncertainty in the $3\alpha$ rate is dominated by that for the $e^+e^-$ branching ratio which is 9.2%. We have performed a new measurement of this quantity aimed at reducing this uncertainty to 5%. 10.4 MeV protons from the Western Michigan University Tandem Van de Graaff accelerator bombarded a 100 $\mu$g/cm$^2$ $^{12}$C target, exciting the 0$^+$ 7.65 MeV state. Protons were detected at backward angles using two 1 mm thick silicon detectors, and coincident $e^+e^-$ were detected with an array of plastic-scintillator detectors where the sensitivity of the device to photons was reduced by dividing the detector into a thick outer block, and thin inner sleeve. The performance of the detector and preliminary results will be discussed. Work supported by the U. S. Department of Energy under contract number DE-FG02-ER1230 (WMU) and the U. S. National Science Foundation, contract numbers PHY06-06007 (MSU) and PHY02-16783 (JINA).

3:36PM BE.00009 Measuring the Radiative Width of the Hoyle State in $^{12}$C, S.A. SHEETS, J.T. BURKE, R.D. HOFFMAN, E.B. NORMAN, L.A. BERNSTEIN, Lawrence Livermore National Laboratory, L.W. PHAIR, J. GIBELIN, M. WIEDEKING, R.M. CLARK, E. VIEITEZ-RODRIGUEZ, Lawrence Berkeley National Laboratory, P. MCMANAHAN, Lawrence Berkeley National Laboratory, J.Y. LEE, A.O. MACCHIELLI, Lawrence Berkeley National Laboratory, C. BEAUSANG, S. LESHER, B. DARAKCHIEVA, M. EVTIMOVA, University of Richmond, B. LYLES, M. DOLINSKI, University of California, Berkeley, H. AI, Yale University — In stellar nucleosynthesis the conversion of helium into heavier elements begins with the triple-$\alpha$ process, in which three $\alpha$ particles combine to form $^{12}$C. The rate of this process is governed by the 0$^+$ second excited state of $^{12}$C which provides a resonance for the $^{12}$C($^{12}$Be)$^{12}$C* at an excitation energy 7.65 MeV (the Hoyle state). Overwhelmingly, the 7.65 MeV state decays by $e^+$ and $e^-$ which were detected with an array of plastic-scintillator detectors where the sensitivity of the device to photons was reduced by dividing the detector into a thick outer block, and thin inner sleeve. The performance of the detector and preliminary results will be discussed. Work supported by the U. S. Department of Energy under contract number DE-FG02-ER1230 (WMU) and the U. S. National Science Foundation, contract numbers PHY06-06007 (MSU) and PHY02-16783 (JINA).

3:48PM BE.00010 The branching ratio of the sub-threshold $1^-$ state in the $\beta$-decay of $^{16}$N, K.E. REJNE, X.D. TANG, M. CARPENTER, J.P. GREENE, R.V. JANSENS, Argonne National Laboratory, J. JISONNA, C.L. JANG, J.C. LISTER, M. NOTANI, N. PATEL, R.C. PARDI, G. SAVARD, J.P. SCHRIFTER, Argonne National Laboratory, T.A. SELEG, Northwestern University, A. WUOSSMAA, Western Michigan University, S. ZHOU, Argonne National Laboratory — A measurement of the $\beta$-delayed $\alpha$ decay of $^{16}$N can give information about the E1 component of the astrophysical S-factor of the $^{12}$C($\alpha,\gamma$)$^{16}$O reaction. The uncertainty in this measurement depends on many parameters, which are used in the fitting procedure. One of them is the ratio of the $\beta$ decay in $^{16}$N, populating the sub-threshold 1$^-$ state in $^{16}$O. We have performed a new measurement of this branching ratio using Gammasphere. The $^{16}$N particles were produced by bombarding a deuterium target with a $^{12}$N beam from the ATLAS accelerator at Argonne. From this experiment a new branching ratio has been obtained, which is about 10% higher than the previous value. The implication of this new value on the S(E1) factor will be discussed. Work was supported in part by the U.S. Department of Energy, Office of Nuclear Physics, under Contract No. DE-AC02-06CH11357 and by the NSF Grant No. PHY-02-16783 (Joint Institute for Nuclear Astrophysics).

Thursday, October 11, 2007 2:00PM - 5:12PM – Session BF Nuclear Theory NewPort News Marriott at City Center Pearl Salon II
2:00PM BF.00001 Defeating The Sign Problem in the Auxiliary-Field Monte Carlo Method for Nuclear Structure: The Shifted-Contour Method \(^1\), GERGANA STOITCHEVA, ERICH ORMAND, Lawrence Livermore National Laboratory — Configuration interaction (CI) methods, which rely on diagonalizing the Hamiltonian within a basis, are often used to develop a fully microscopic description for quantum many-body systems. However, in nuclear applications, they are limited in their applicability because the basis dimension grows dramatically with particle number. Since the computational effort for the Auxiliary-field Monte Carlo (AFMC) method scales more gently with particle number, it is a natural approach for large-scale problems. However, AFMC is often crippled by the notorious sign problem, which essentially makes the Monte Carlo sampling impossible. The sign problem substantially limits the efficacy of the AFMC method, and has limited nuclear applications to only even-particle systems with simple schematic interactions or the extrapolation method. We report a novel, but straightforward, solution to the sign problem: the shifted-contour method. We show exact results for sd- and fp-shell nuclei with fully realistic interactions without reliance on extrapolations.

1This work performed under the auspices of the University of California, Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48, and was supported under LDRD contract 06-LW-013.

2:12PM BF.00002 Defeating The Sign Problem in the Auxiliary-Field Monte Carlo Method for Nuclear Structure: Level Densities and Other Properties \(^1\), ERICH ORMAND, GERGANA STOITCHEVA, Lawrence Livermore National Laboratory — The auxiliary-field Monte Carlo method (AFMC) within the thermal formalism permits an opportunity to probe structure properties such as nuclear level densities and Gamow-Teller strength distributions. These properties play an essential role for estimates of reaction rates in various astrophysical nucleosynthesis processes. Most conventional calculations of the nuclear level density are based on the back-shifted Fermi gas model. These calculations involve empirical parameters that can lead to large uncertainties in determining the reaction rates. The AFMC is the only approach that allows the determination of nuclear properties at finite temperature that includes the full effect of correlations among the valence nucleons in large model spaces. Using the shifted-contour method to defeat the sign problem we report on the first results of various nuclear properties, including nuclear level densities, using fully realistic shell-model interactions.

1This work performed under the auspices of the University of California, Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48, and was supported under LDRD contract 06-LW-013.

2:24PM BF.00003 Shell-Model Effective Interactions from the No-Core Shell Model \(^1\), BRUCE BARRETT, ALEXANDER LISETSKIY, MICHAEL KRUSE, University of Arizona, PETR NAVRÁTLÍK, Lawrence Livermore National Laboratory, JAMES VARY, Iowa State University — The extension of the No-Core Shell Model (NCSM) approach \(^1\) to heavier nuclei (i.e., to the sd- and pf-shells) is a challenging problem. Standard shell-model calculations usually employ either empirical or theoretical effective two-body matrix elements (TBME), which contain excluded many-body correlations. We show how a NCSM investigation in a 4\(\hbar\Omega\) model space can yield TB sd-shell ME, which exactly reproduce the many-body correlations present in the original calculation. We demonstrate how the effective Hamiltonian derived in the 4\(\hbar\Omega\) NCSM at the 2-body cluster level should be modified to properly account for the many-body correlations produced by truncating to a single major shell. The capability of these standard sd-shell TBME for \(^{10}\)F, obtained by direct projection, to reproduce the results of large scale NCSM calculations for F, Ne and Na isotopes will be shown.


J.P.V. supported partly by USDOE grant DE-FG-02-87ER40371.

2:36PM BF.00004 Effective Interactions for pf Shell from the No Core Shell Model \(^1\), ERDAL DİKMEN, Suleyman Demirel University, The University of Arizona, ALEXANDER LISETSKIY, BRUCE BARRETT, The University of Arizona, PETR NAVRÁTLÍK, Lawrence Livermore National Laboratory, JAMES VARY, Iowa State University — Following the ideas of the Tucson nuclear theory group for the extension of the No-Core Shell Model (NCSM) approach to sd-shell nuclei \(^1\), we show how a NCSM calculation for \(^{42}\)Ca in a 2\(\hbar\Omega\) model space can yield two-body effective interactions for the pf-shell. We demonstrate how the effective Hamiltonian derived in the 2\(\hbar\Omega\) NCSM at the 2-body cluster level should be modified to properly account for the many-body correlations produced by truncating to a single major shell. The pf-shell two-body effective interactions for \(^{42}\)Ca, obtained by direct projection, are used to reproduce the results of large scale NCSM calculations for other Ca isotopes.

B. R. Barrett et al., DNP 2007 abstract.


J.P.V. supported partly by USDOE grant DE-FG-02-87ER40371.

2:48PM BF.00005 Partial Dynamical Symmetries, LARRY ZAMICK, Rutgers University — Two examples of partial dynamical symmetries are presented. 1) The \(j=9/2\) shell of identical particles e.g. neutrons affords the first shell where one can have seniority mixing via a two-body interaction. It was however noted by Escuderos and Zamick that even with a seniority violating interaction certain states remain pure. For \(4\) neutrons in the 9/2 shell for total angular momentum \(I=4\) there is one pure seniority \(v=4\) state. This does not mix with the single seniority \(V=2\) state or with the other \(v=4\) state. A proof is presented showing that this special state does not mix with \(V=2\). A similar scenario plays out for \(I=6\). 2) In \(^{44}\)Ti if we sent the two=body \(T=0\) matrix elements to zero, keeping only \(T=3\), then in the single \(j\) shell model we get degeneracies of certain states e.g. a \(3,7,9,+, 10+\) state are all degenerate. The "symmetry" is partial because we do not get degeneracies for \(I=0, 2, 4, 6, 8\). The explanation is that the symmetry only occurs if in \(^{44}\)Ti (2 protons and 2 neutrons) the total angular momenta are ones that cannot occur for 4 identical particles e.g. \(^{44}\)Ca. Where the partial dynamical symmetry applies \(Jp\) and \(Jn\) are good "dual" quantum numbers for all the \(T=0\) states.

3:00PM BF.00006 The effect of magnetic field to the pairing phase transition of mesoscopic system\(^1\), TONY SAMURAYDA, ALEXANDER VOLYA, Department of Physics Florida State University — In this presentation we discuss pairing phase transitions in mesoscopic system. We investigate the role played by the magnetic field which is equivalent to rotation within the cranking model. Using exact solution of pairing we examine spin fluctuations, magnetization, specific heat, energy, and entropy for several systems with various statistical approaches. We emphasize a resemblance between observed mesoscopic properties and those known in the macroscopic physics of superconductors. At low field the normal and superconducting phases are separated by the second order phase transition. In the next region of higher magnetic field the normal and superconducting phases are separated by the transition of a different nature associated with a simultaneous peak in spin susceptibility and enhanced spin fluctuations. Finally, at even higher fields a superconducting state is not supported at all.

1This work is supported by the U.S. Department of Energy, grant DE-FG02-92ER40750.
3:12PM BF.00007 Band Terminations and Density Functional Theory: A Critical Analysis¹. ANATOLI AFANASJEV, Mississippi State University — It was recently suggested in Refs. [1,2] that the set of terminating states in the N∼Z, A∼44 mass region provides unique and reliable constraint on time-odd mean fields and the strength of the spin-orbit interaction in Skyrme and covariant (relativistic) density functionals. The authors of these references claim that their method based on the energies of terminating states is free from the drawbacks of standard approaches to define the strength of the spin-orbit interaction employing the single-particle energies of the spin-orbit partner orbitals in spherical nuclei. If that would be true the isoscalar and isovector channels of spin-orbit interaction could be defined very accurately. However, the detailed analysis performed shows that this is not the case. The results of this analysis will be presented in the talk.


¹The research was supported by U.S. Department of Energy under contract DE-FG02-07ER41450.

3:24PM BF.00008 Recent progress with \textit{ab initio} calculations of the nuclear equation of state¹, FRANCESCA SAMMARRUCA, University of Idaho — The properties of dense nuclear matter is a topic of current interest. More empirical information is becoming available through heavy-ion collision data and astrophysical observations, which can help set constraints on the equation of state (EOS) of nuclear matter in different density regions². In this contribution, I will present recent progress within the \textit{ab initio} approach pursued by my group. Our goal is to gain a broad overview over nuclear matter properties, especially under the “exotic” conditions of isospin and spin asymmetry. Moreover, the impact of non-nucleonic degrees of freedom on the EOS at higher densities will be discussed.


3:36PM BF.00009 Origin of Apparent Negative Heat Capacity in Constrained Microcanonical Modeling of Excited Nuclear Systems, MICHAEL QUINLAN, JAN TÖKE, IWONA PAWELCZAK, Department of Chemistry, University of Rochester, Rochester, New York 14627, WOLF-UDO SCHRÖDER, Departments of Chemistry and Physics, University of Rochester, Rochester, New York 14627 — The origin of negative heat capacity in certain classes of microcanonical models of phase transitions in small systems is studied. It is demonstrated that the domain of negative heat capacity appears in such calculations as a result of an unphysical discontinuity in the model phase space and, specifically, the exclusion of energetically (microcanonically) allowed micro-states filling the space between the domains corresponding to different phases. It is also shown that already a crude filling of these unphysical gaps in the phase model phase space results in a restoration of the concavity of the entropic curve $S(E^*)$ and thus in an elimination of the faux negative heat capacity in the phase transition region.

3:48PM BF.00010 Nuclear Multifragmentation as Generalized Fission¹, JAN TÖKE, UDO SCHRÖDER, University of Rochester — An explanation for the phenomenon of statistical nuclear multifragmentation is presented within the framework of thermodynamical theory. Within this framework, multifragmentation occurs as a result of interplay between the disruptive Coulomb and/or centrifugal forces and cohesive surface free energy (surface tension) in a system undergoing fast statistical shape fluctuations—a process similar to binary fission, except that generalized to multifragment decay channels. The process sets in at elevated excitation energies where it relies on thermal reduction of surface tension. It is gentle in that it does not involve violent collective flows of matter. Rather, the highly excited and shape-fluctuating system gets torn apart slowly by Coulomb forces as, aided by decreasing surface free energy, it reaches on fast time scales any of the very many possible multifragment saddle configurations.

[1] This work was supported by the U.S. Department of Energy grant No.DE-FG02-88ER40414.

4:00PM BF.00011 Density-constrained TDHF calculation of fusion cross sections for neutron-rich nuclei¹, VOLKER OBERACKER, Vanderbilt University, SAIT UMAR — We have developed a new microscopic approach for calculating heavy-ion fusion cross sections. The method is based on the TDHF evolution of the nuclear system coupled with density-constrained Hartree-Fock calculations to obtain the heavy-ion interaction potential. This approach incorporates all of the dynamical entrance channel effects such as neck formation, particle transfer, internal excitations (including giant resonances), and dynamical deformation effects. In particular, we focus on systems involving one or two deformed nuclei ($^{64}$Ni, $^{20}$Sn) in which case the dynamical nuclear alignment arising from multiple Coulomb excitation must be taken into account. Fusion cross sections below and above the barrier are calculated using the incoming wave boundary condition (IWBC) method. A recently completed analysis [Ref. 1] of the neutron-rich system $^{64}$Ni+$^{122}$Sn will be presented, and we will also discuss new preliminary results for the $^{64}$Ni+$^{64}$Ni system where experimental data show a hindrance of subbarrier fusion.


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

4:12PM BF.00012 Random Interactions on 2-Level Systems¹, DECLAN MULHALL, University of Scranton — The systematics of the regularities of the spectra of systems of $N$ particles on 2 spin-$j$ levels interacting under random 2-body interactions with certain global symmetries exhibit regularities. A statistical theory is developed to explain these regularities, based on the statistical mechanics of a quantum gas. A comparison is made with the Interaction Boson Model.

¹Physics/EE Dept., University of Scranton

4:24PM BF.00013 Relative elemental and meson production rates in the collision of space crafts with cosmic particles, M.S. SABRA, F.B. MALIK, Southern Illinois University Carbondale — Modified statistical model that includes final state interaction between two binary fragments in the collision of a target nucleus with hydrogen and helium has been successful in explaining the existing data of alpha induced fragmentation of $^{28}$Si, a major component in semi-conductors instruments. Proton induced collision of $^{16}$O will be presented along with calculated production rates of all allowed elements and their isotopes. The observed data indicates that the fragments are pre-dominantly emitted in excited states, and have broad kinetic energy distributions, which are accounted for by this theory but not by the usual evaporation models. The nature of the potentials between two emerging fragments in the final state and their level density functions are the important factors in determining their kinetic energy spectra and degree of excitations. The collision between materials of space crafts and cosmic particles leads to copious emission of hot nuclei, a factor that must be added to the existing data base needed for developing protection against space radiations. A preliminary study of the possibility of meson productions and the emission of the residual hot-nuclei in the process that could subsequently emits further hot nuclei will also be discussed.
The time-dependent, relativistic Aharonov-Bohm effect. ZACHARY KERTZMAN, ATHANASIOS PETRIDIS, Drake University — It is known that the Aharonov-Bohm effect provides a definite proof that charged fermions couple directly to the 4-vector potential. Numerical, time-dependent solutions to the relativistic Dirac equation coupled with an external electromagnetic field are produced in order to study this phenomenon in detail. The staggered leap-frog method is used on a spatial lattice. The numerical stability of the method in two dimensions is a crucial issue. It is studied analytically and ensured by taking appropriately small time-steps. The action of the magnetic potential in the region of zero magnetic field is evaluated by means of the diffraction patterns it produces.

The Explanation of the Photon's Electric and Magnetic Fields; and its Particle and Wave Characteristics. RUSSELL MOON, Dr., VICTOR VASILIEV, Pr. — Using the principles of the Vortex Theory, the creation of the photon's electric and magnetic components are explained: the condensed region of space is responsible for creating the photon's electric component and its particle effect; its expansion and contraction is responsible for its frequency; its motion through three dimensional space creates a wave in the surrounding space. This wave is responsible for the photon's magnetic component and wave characteristics. The simultaneous expansion and contraction of both the dense region of space that is the photon and the surrounding space it passes through explains why the electric and magnetic effects are at right angles to each other. Also the photon's particle and wave characteristics are explained. 1.Russell Moon, The Bases of the Vortex Theory of Space. Publishing house of ZNAK, Moscow, Russia, 2002, 32 pp. (in Russian). 2. R.G. Moon, The Possible Existence of a New Particle: the Neutral Pentaquark? Book of materials, The Research Centre of Ecological Safety of the Russian Academy of Sciences: Scientific Seminar 0f Ecology and Space I, February 22, 2005, Saint-Petersburg, Russia, 2005, pp. 98-104.
2:48PM BG.00005 Study of low-lying resonant states in $^{16}$F using an $^{15}$O radioactive ion beam

DONGWON LEE, LBNL, KARI PERAJARVI, STUK, Finland. JAMES POWELL, JIM O'NEIL, LBNL, DENNIS MOLTZ, University of California, Berkeley, VLADILEN GOLDBERG, Texas A&M University, JOSEPH CERNY, LBNL — Among the A=16, $T=1$ isobaric triad, many states in $^{16}$O and $^{16}$N have been well established, but less has been reported about $^{16}$F. Experimental studies with stable beams have established spin-parity values for the first four low-lying states of $^{16}$F, but only upper limits or rough estimates of their level widths have been reported. The spins and parities of the low-lying states have been found to be 0$^{-}$, 1$^{-}$, 2$^{-}$, and 3$^{-}$ in $^{16}$F. The level widths of the first four states in $^{16}$F were determined using R-matrix analysis, and our results show that the 0$^{-}$ state has a level width of 22.8 ± 14.4 keV, and that the broad 1$^{-}$ state has a width of 103 ± 12 keV. The level width of the 2$^{-}$ state is found to be 4.0 ± 2.5 keV which is much narrower than the compiled value, while 15.1 ± 6.7 keV for the 3$^{-}$ state is in good agreement with previous studies.

3:00PM BG.00006 Coupled SU(3) models of rotational states in nuclei and quasi-dynamical symmetry

GABRIELA THIAMOVA, Department of Applied Mathematics, University of Waterloo,Waterloo, Ontario, Canada. DAVID JOHN ROWE, Department of Physics, University of Toronto, Toronto, Canada — This work reports a first step towards the development of a model of low-lying nuclear collective states based on the progression from weak to strong coupling of a combination of systems in multiple SU(3) irreps. The motivation for such a model comes partly from the persistence of rotational structure observed experimentally and in many calculations. This work considers the spectra obtainable by coupling two SU(3) irreps via a qadr-qadr interaction. For a particular value of this interaction, the two irreps combine to form strongly-coupled irreps while for zero interaction the results are mixtures of many such strongly-coupled irreps. A notable result is the persistence of the rotor character of the low-energy states for a wide range of the interaction strength. Also notable is the fact that, for very weak interaction strengths, the energy levels of the yrast band resemble those of a vibrational sequence while the B(E2) transition strengths are close to those of an axially symmetric rotor, as observed in many nuclei. An application to shape coexistence in $^{16}$O is considered to show that the model gives an indication of which np-nh states are likely to contribute to the low-energy states of nuclei.

3:12PM BG.00007 Unbound states of the neutron-rich oxygen isotopes

C.R. HOFFMAN, S.L. TABOR, FSU, M. THOENENNESSE, T. BAUMANN, D. BAZIN, A. GADE, W.A. PETERS, A. SCHILLER, MSU/NSCL, J. BROWN, P.A. DEYOUNG, R. HOWES, MARQUETTE, N. FRANK, B. LUTHER, CONCORDIA, H. SCHEIT, RIKEN, J. HINNEFELD, IUSB, MONA COLLABORATION — The energies of the ground state decay of $^{25}$O and excited states in $^{24}$O were measured for the first time. From these energies the size of the N = 16 shell gap may be deduced. Due to the lack of observation of an excited state in $^{24}$O using γ-ray spectroscopy, along with the known unbound nature of $^{25}$O, techniques involving neutron spectroscopy had to be applied. $^{25}$O ($^{24}$O) was populated via proton (proton-neutron) removal from a $^{26}$F beam. Complete 4-vector reconstruction revealed resonant structures in the decay spectrum for n-$^{22}$O, n-$^{23}$O and n-$^{24}$O coincidence events. From the n-$^{24}$O and n-$^{23}$O decay spectrum the energies of the ground state of $^{25}$O and first excited state of $^{24}$O were measured. Using n-$^{22}$O coincident events of neutron multiplicity ≥ 2, clear correlation between a low and high energy resonance was observed. With the known placement of the low energy resonance as the first excited state in $^{25}$O, the high energy resonance has been attributed to an excited state in $^{24}$O.

This work was supported by the US National Science Foundation.

3:24PM BG.00008 Structure of $^{21}$Mg excited states studied in single neutron knockout

C. AA. DIGET, P. ADRICH, D. BAZIN, M.D. BOWEN, B.A. BROWN, C.M. CAMPBELL, J.M. COOK, A. GADE, T. GLASMACHER, A. MCDANIEL, A. OBERTELLI, K. SIWEK, J.R. TERRY, D. WEISSHAAR, National Superconducting Cyclotron Laboratory, Michigan State University, Michigan, K. HOSIER, D. MCGLINCHERY, L. RILEY, Department of Physics and Astronomy, Ursinus College, Pennsylvania — Previously, the $^{21}$Mg excited-state properties have been studied using the three-neutron transfer reaction $^{24}$Mg($^3$He,$^3$He)$^{21}$Mg directed by comparison to the $^{21}$F mirror nucleus. When comparing the experimental results to USD shell-model calculations, however, significant discrepancies are found. To resolve these discrepancies, we investigated the nucleus in a one-neutron knockout reaction $^{20}$Be($^{15}$Mg,$^{15}$Mg)$^{21}$X and studied the subsequent γ decay using in-beam γ-ray spectroscopy. From the γ-decay measurement, energies of the excited states were determined. Furthermore, properties of the states were identified through the decay branching ratios to lower lying states, the spectroscopic factors for the $^{22}$Mg ground state with respect to the individual $^{21}$Mg states, and the longitudinal momentum distribution of the residual nucleus which is sensitive to the orbital angular momentum of the knocked-out neutron.

Supported by NSF grants: PHY-0600007 and PHY-0555366.

3:36PM BG.00009 Coulomb Excitation of Radioactive $^{21}$Na with TIGRESS and BAMBINO

MICHAEL SCHUMAKER, University of Guelph, TIGRESS AND BAMBINO COLLABORATION — The first experiment to use modules of the TRIUMF-ISAC Gamma-Ray Escape-Suppressed Spectrometer (TIGRESS) with an accelerated radioactive ion beam has been performed successfully, using the ISAC facility at TRIUMF. The low-energy structures of the five-particle nuclei $^{21}$Na and $^{21}$Ne were examined, in order to test model predictions of these deformed nuclei. For $^{21}$Na, the ±86% uncertainty on the previously accepted B(E2) value, resulting from the dominance of M1 decay in these nuclei, has made comparison difficult. Beam particles were accelerated to 1.7 MeV/A, and Coulomb excited in a “$^{12}$C” target. Recoiling projectile and target ions were detected by the BAMBINO segmented silicon detector, while γ-ray yields were determined using two TIGRESS detectors perpendicular to the beam axis. For $^{21}$Na and $^{21}$Ne, Coulomb excitation from the 3/2$^+$ ground state to the 5/2$^+$ state was observed. Strongly enhanced B(E2) values were determined, which will be compared with the simplest quadrupole rotor model, and shell model predictions.

Supported by the Natural Sciences and Engineering Research Council of Canada, the DOE, UC-LLNL, Contract W-7405-ENG-48, the National Science Foundation, and the U.K. Engineering and Physical Sciences Research Council.

3:48PM BG.00010 Ground state properties of pf shell even-even nuclei in a mean-field model with a modified separable monopole interaction.

JIRINA STONE, University of Oxford, WILLIAM WALTERS, University of Maryland — The non-relativistic Hartree-Fock mean field model with modified separable monopole interaction has been used to calculate ground state properties of even-even 20$^{<}$Z$<32$ nuclei, including binding energies, mean-square radii, charge density distributions, neutron skins and geometrical shapes. Parameters of the separable interaction are adjusted to known properties of finite nuclei, including nuclei away from closed shells, as well as to expected features of symmetric and asymmetric nuclear matter and the mass-radius relationship in cold, non-rotational neutron stars. The results are compared to the outcome of the same model with more traditional Skyrme-type interactions SLy4 and SkI3. The similarities and differences of the models are discussed and attributed to the treatment of isospin degrees of freedom. Calculated bulk properties, such as binding energies and shape parameters, are also compared to the Finite-Range-Liquid-Droplet (FRLD) model predictions.

Supported by US DOE grant DE-FG02-94ER40834.
4:00PM BG.00011 Shell structure near $^{42}$Si: one proton knockout from $^{44}$Si$^+$. L.A. RILEY, T.R. BAUGHER, K.E. KOSIER, Ursinus College, P.D. COTTLE, K.W. KEMPER, Florida State University, P. ADRICH, D. BAZIN, J.M. COOK, C. AA. DIGET, A. GADE, D.A. GARLAND, T. GLASMACHER, A. RAKIJEVICZ, K.P. SIWEK, D. WEISSHAAR, National Superconducting Cyclotron Laboratory, Michigan State University — The $d_{5/2}$ proton strength in $^{44}$Si$^+$ was studied via the one-proton knockout reaction $^{8}$Be$(^{44}$Si$^+, pf)$X. Gamma rays were measured in coincidence with the knockout products. We extracted spectroscopic factors of states populated in the reaction from measured parallel momentum distributions. An expanded level scheme will be presented and the size of the $Z=14$ proton subshell closure will be discussed.

1Supported by NSF grant nos. PHY-0606007, PHY-0355129, and PHY-0653323.

4:12PM BG.00012 Determination of effective charges in the lower $pf$ shell$^1$, J.M. COOK, P. ADRICH, D. BAZIN, M.D. BOWEN, B.A. BROWN, C.M. CAMPBELL, A. GADE, T. GLASMACHER, S. MCDANIEL, A. OBERTELLI, K. SIWEK, J.R. TERRY, D. WEISSHAAR, National Superconducting Cyclotron Laboratory, Michigan State University — Recently, the use of the standard effective charges, $e^*_{n}=1.5$ and $e^*_p=0.5$, has been called into question, and the noncanonical values of $e^*_n=1.15$ and $e^*_p=0.8$ have been suggested for the upper $fp$ shell. $^{40}$Ca is ideally suited for determining the $e^*_p$, effective charge due to its closed $\pi_{1/2}$ shell. The results of the measurement of the B(E2; $0^+ \rightarrow 2^+$) transition rate in $^{40}$Ca, which is proportional to $e^*_{p}^{2}$ via intermediate-energy Coulomb excitation at the National Superconducting Cyclotron Laboratory will be reported. In this experiment, $\gamma$ rays were observed using the high-efficiency NaI APEX Array in conjunction with particle identification by the S800 Spectrograph.

$^1$This work is supported by the National Science Foundation through grant PHY-0606007.

4:24PM BG.00013 Level densities of residual nuclei from the reaction Li6 on Fe58. Babatunde Oginni, Steven Grimes, Alexander Voineo, Aderemi Adekola, Carl Brune, Don Carter, Zack Heinen, Ohio University, Michael Hornish, Tom Massey, Ohio University, Catalin Matei, Oak Ridge National Laboratory, John O'Donnell, Ohio University — We investigated the level densities of residual nuclei from compound reactions using a Li6 beam. The (Li6,p) and (Li6,He) reactions have been studied at 15MeV for a Fe58 target. Proton and alpha spectra were measured at angles 23.5, 37.7, 68, 98, 142.5 and 157.5 over a range of excitation energies in the residual nuclei. The contribution of the breakup reaction to the residual nuclei was studied from Li6 on Au197 reaction. The evaporated spectra have been compared with theoretical models based on Hauser-Feshbach and Empire codes. We present some of the results obtained.

1Work Supported by Department of Energy

4:36PM BG.00014 GFMC Calculations of Isospin-Mixing in $^8$Be$^1$, Robert B. Wirina, Steven C. Pieper, Muslem Pervin, Argonne National Laboratory — $^8$Be has two $2^+$ states at 16.6 and 16.9 MeV excitation that are strongly isospin-mixed. We have performed microscopic Green's function Monte Carlo calculations of the isospin-mixing matrix elements between the T=0 and 1 states using the realistic Argonne $v_{18}+\text{Illinois-2}$ Hamiltonian, which includes strong CSB components and a full electromagnetic interaction. We obtain 80% of the empirically-determined matrix element, with 2/5 of our result coming from the terms beyond Coulomb, confirming an earlier variational study. We have also calculated the mixing between the nearby T=0,1 pairs of 1$^+$ and 3$^+$ states. Finally, we have examined the mixing of the T=1 2$^+$ states with the first T=0 excited 2$^+$ state at 3.0 MeV, which is the final state for weak decays from either $^8$Li or $^8$B. We find this state, which is an important laboratory for testing various aspects of weak interactions, to have extremely small T=1 contamination.

1Work supported by U.S. Department of Energy, Office of Nuclear Physics, under Contract No. DE-AC02CH11357; computations performed at the LCRC facility of Argonne National Laboratory

Thursday, October 11, 2007 2:00PM - 3:36PM –
Session BH Applications of Nuclear Physics Newport News Marriott at City Center Blue Point I

2:00PM BH.00001 Nuclear Physics on Critical Path for Space Missions, Ram Tripathi, NASA Langley Research Center — Protection from hazards of space radiation has been identified as one of the five NASA's critical areas for human space flights. The space radiation environment consists of galactic cosmic rays (GCR), solar particle events (SPE), trapped radiation, and includes ions of all the known elements over a very broad energy range. These ions penetrate spacecraft materials producing nuclear fragments and secondary particles that damage biological tissues, electronics against the hazards of severe deep space radiation. Accurate risk assessments critically depend on the accuracy of the input information about the interaction of ions with materials, electronics and tissues. Due to paucity of the huge amount of needed experimental input data about the interaction of radiation, it is imperative to develop reliable accurate models of nuclear reactions and structures that form the basic input ingredients. State-of-the-art nuclear cross sections models have been developed at the NASA Langley Research center. The vital role and importance of nuclear physics for space missions would be discussed.

2:12PM BH.00002 Can we use the equivalent sphere model to approximate organ doses in space radiation environments? Zi-Wei Lin, East Carolina University — For space radiation protection it is often useful to calculate dose or dose equivalent in blood forming organs (BFO). It has been customary to use a 5cm equivalent sphere to approximate the BFO dose. However, many previous studies have concluded that a 5cm sphere gives very different dose values from the exact BFO values. A study by Bier, Townsend and Maxwell (Adv. Space Res. 21, 1998) concludes that a 9cm sphere is a reasonable approximation for BFO doses in solar particle event environments. In this study we use a deterministic radiation transport to investigate the reason behind these observations and to extend earlier studies. We take different space radiation environments, including solar particle events and galactic cosmic rays at different solar modulation, and calculate the dose and dose equivalent in the skin, eye and BFO using their thickness distribution functions from the Computerized Anatomical Man model. We then determine in which cases and at what radius parameters the equivalent sphere model is a reasonable approximation.
2:24PM BH.00003 Preliminary tests of a high performance LaBr₃ gamma imager for small animals. J. JIANGUO QIAN, Applied Science Dept., College of William and Mary, ERIC BRADLEY, Biology Dept. & Applied Science Dept., College of William and Mary, STAN MAJIEWSKI, JOHN MICKISSON, VLADIMIR POPOV, JAMES PROFFITT, Detector and Imaging Group, Jefferson Lab, MARGARET SAHA, Biology Dept., College of William and Mary, JONATHAN SUTTON, Physics Dept., College of William and Mary, ANDREW WEISEMBERGER, Detector and Imaging Group. Jefferson Lab, ROBERT WELSH, AMIR YAZDI, Physics Dept., College of William and Mary — A novel medical gamma ray imager comprised of an array of four Hamamatsu H9500 position sensitive photomultiplier tubes (PSPMT) coupled directly to a single slab of LaBr₃ scintillator has been designed and tested. The phototube-scintillator array, fabricated by Bicron-St. Gobain Inc (France), is the first such device made. A special resistive readout array designed here permits signals from the 256 anode pads in each PSPMT to be read out on only 16 data lines. Preliminary tests of uniformity, sensitivity and resolution will be described along with initial images of mice obtained with this new device.

1Research funded in part by the U. S. DOE, The U. S. NIH (Grant EB000458-02).

2:36PM BH.00004 Polarization and Relaxation of Radon. ERIC TARDIFF, TIMOTHY CHUPP, WOLFGANG LORENZON, SARAH NUSS-WARREN, University of Michigan Physics Department, JOHN BEHR, MATTHEW PEARSON, TRIUMF, KERIM GULUYZ, RICHARD LEFFERTS, NORBERT PIETRALLA, GEORGI RAINOVSKI, JERRY SELL, GENE SPROUSE, SUNY Stony Brook Department of Physics and Astronomy — The polarization and relaxation of ²²⁶Rn collected in coated and uncoated glass optical pumping cells was studied at SUNY Stony Brook’s Francium Lab. On the order of one million atoms per cell were collected, and polarized by spin exchange with laser-polarized rubidium. Gamma rays and positrons were measured as a signal of the alignment (the second order moment of the polarization) resulting from the combination of polarization and quadrupole relaxation at the cell walls. The temperature dependence over the range 130°C to 220°C shows the anisotropies increasing with increasing temperature as the ratio of the spin exchange polarization to the wall relaxation rate increases faster than the rubidium polarization decreases. Subsequent rubidium fluorescence polarimetry studies determine the level of rubidium polarization in the cells under similar conditions. Polarization relaxation rates, promising for electric dipole moment measurements of octupole-deformed radon isotopes, have been extracted from the gamma-ray data, and improved limits on the multipole mixing ratios of some of the main gamma-ray transitions have been determined.

2:48PM BH.00005 Updated Decay Data Library for Actinides. F.G. KONDEV, I. AHMAD, J.P. GREENE, Argonne National Laboratory, A.L. NICHOLS, M.A. KELLETT, International Atomic Energy Agency — Accurate decay data for actinide nuclides and their decay chains are important in the nuclear fuel cycles of both thermal and fast reactors. These data have also found increasing application in many other power-related fields such as fuel manufacture and reprocessing, waste storage and management, nuclear facility design, safety assessments and safeguards/proliferation issues. Specific requirements for improved actinide decay data have been outlined in a recent review by Nichols [1]. As a consequence of this review and debate within the nuclear data community, an IAEA Coordinated Research Project (CRP) on “Updated Decay Data Library for Actinides” was initiated in October 2005. Staff from various research laboratories in seven countries and one international body are involved in these efforts to quantify with greater accuracy the complete decay data for almost 40 actinides and 45 of their daughters. An overview of the IAEA CRP programme will be presented, including the present status of the on-going work. Results from new measurements of the decay properties of a number of nuclei, such as ²⁴⁰Pu, ²³⁴–²³⁵Cm and ²⁴⁹Cf, will also be presented and discussed. This work was supported by the U.S. Department of Energy, Office of Nuclear Physics, under Contract No. DE-AC02-06CH11357.

3:00PM BH.00006 Neutron-Induced Partial Gamma-Ray Cross-Section Measurements on Uranium at TUNL. A. HUTCHESON, A.S. CROWELL, J.H. ESTERLINE, B. FALLIN, C.R. HOWELL, M. KISER, A.P. TONCHEV, W. TORNOW, Duke University/TUNL, J.H. KELLEY, North Carolina State University/TUNL, C.T. ANGELL, M. BOSWELL, H.J. KARWOWSKI, University of North Carolina/TUNL, R.O. NELSON, Los Alamos National Laboratory — Precision measurements have been performed on ²³⁵U targets at Triangle Universities Nuclear Laboratory using a monoenergetic neutron beam. The excitation function of (n,2n) reaction has been studied with incident energies between 5 and 15 MeV and beam flux of 10⁴ n s⁻¹ cm⁻² at target position. Multiple (n,n') and (n,2n) partial cross sections have been measured using clover and planar HPGe detectors in this energy range, and results will be compared with the Hauser-Feshbach model. A more in-depth explanation of the techniques and analysis will be presented.

1Supported by the NNSA under the Stewardship Science Alliance Programs through DOE Research Grant DE-FG03-02NA00073.

3:12PM BH.00007 Measurement of the ²⁴¹Am(n,2n) reaction cross section from 7.6 to 14.5 MeV. A. TONCHEV, Duke and TUNL, C. ANGELL, UNC and TUNL, J. BECKER, LLNL, E. BOND, LANL, D. DASHDORJ, LLNL, B. FALLIN, Duke and TUNL, J. FITZPATRICK, LANL, C. HOWELL, A. HUTCHESON, Duke and TUNL, H. KARWOWSKI, UNC and TUNL, J. KELLEY, NCSU and TUNL, R. MACRI, LANL, W. TORNOW, Duke and TUNL, D. VIEIRA, LANL, J. WILHELMY, LANL and LLNL, C. WU, LLNL — High-precision measurements of the ²⁴¹Am(n,2n)²⁴⁰Am reaction have been performed with neutron energies from 7.6 to 14.5 MeV. The monoenergetic neutron beams were produced via the ²³⁵U(He,d)²³⁶U reaction using the 10 MV tandem accelerator at TUNL. The radioactive targets consisted of 1mg highly enriched ²⁴¹Am, sandwiched between three different thin monitor foils. They were irradiated with a neutron flux of 3x10¹¹ n cm⁻² s⁻¹. After each irradiation the induced activity in the targets and monitors was measured off-line with 60% HPGe detectors. Our neutron induced cross sections will be compared with recent literature results and statistical model calculations.

3:24PM BH.00008 The Explanation of Quantum Teleportation and Entanglement Swapping. RUSSELL MOON, Dr., VICTOR VASILEV, Pr. — According to the Vortex Theory, the rotation of a particle causes the surrounding three-dimensional space to rotate creating the particle’s electromagnetic characteristic. Because three-dimensional space is the surface of fourth-dimensional space, this rotation extends slightly downward into the fourth-dimensional volume beneath. If two photons possessing complementary polarizations are “entangled”, this extreme closeness forces their rotations extending into fourth-dimensional space to join together forming a vortex. When the particles are separated, the vortex between them remains. A change in the orientation of a photon at one end of the vortex travels in a wave down the length of the vortex creating a change in the orientation of the photon at the other end. Entangled separated particles of matter such as electrons are similarly connected and effected by each other. The breaking and reconnecting of these vortices also explains the phenomenon of entanglement swapping. 1R.G. Moon. The Possible Existence of a New Particle: the Neutral Pentaquark? Book of materials, The Scientific Seminar Ecology and Space 1, February 22, 2005, Saint-Petersburg, Russia, 2005.
9:00AM CA.00001 Nucleosynthesis in the early Galaxy, FERNANDO MONTES, NSCL — Recent observations of the abundances in metal-poor stars suggest that an additional mechanism besides the r-process is responsible for the production of material in the region Z \leq 47. Mixing of a light element primary process (LEPP) and the r-process pattern found in r-II metal-poor stars explain the apparent non-uniformity in their abundances. The LEPP abundance pattern based on those observations is used to explore the astrophysical conditions that would create it within a site-independent approach. In addition, a solar LEPP contribution is obtained by subtracting the contributions of other nucleosynthesis processes and it can be used to obtain information in the important A = 130 abundance peak. The likely nature of the LEPP and its potential relevance for the s-process will be discussed.

9:36AM CA.00002 Exposing the Nuclear Burning Ashes of Radius Expansion Type I X-Ray Bursts, NEVIN WEINBERG, University of California at Berkeley — Type I X-ray bursts are powered by thermonuclear burning of freshly accreted H and He on the surface of a neutron star in a low-mass X-ray binary. The ashes of this burning are ordinarily hidden from view, buried well below the overlying photosphere. We show, however, that some of these ashes become exposed during especially bright X-ray bursts, known as photospheric radius expansion bursts. During such bursts, a radiation-driven wind forms, which our calculations show ejects as much as 1% of the recently forged ashes of burning. The spectral signature of these ejected ashes should be detectable with current high-resolution X-ray telescopes. A detection would help constrain the nuclear burning processes and might enable a measurement of the gravitational redshift of the neutron star.

Friday, October 12, 2007 9:00AM - 12:12PM
Session CB Mini-Symposium on Studying the Orbital Structure of the Proton with Di-Jets at RHIC

9:00AM CB.00001 Transverse momentum and transverse spin in hadronic scattering, FENG YUAN, Brookhaven National Lab — In this talk, I will present a theoretical overview of the transverse momentum and transverse spin physics in hadronic reactions.

9:36AM CB.00002 HERMES Measurement of the Collins and Sivers Asymmetries from a Transversely Polarized Hydrogen Target, EDWARD KINNEY, University of Colorado, HERMES COLLABORATION — In 2005 the HERMES collaboration published first evidence for azimuthal single-spin asymmetries in semi-inclusive production of charged pions on a transversely polarised hydrogen target. The measured asymmetries are caused by both the Collins and the Sivers mechanisms. Their distinctive Fourier components provide signals to previously unmeasured quantities: the transversity quark distribution in conjunction with the Collins fragmentation function (Collins mechanism/asymmetry) and the Sivers parton distribution (Sivers mechanism/asymmetry). The transversity distribution will provide new insight into the relativistic nature of the quarks and parton orbital angular momentum. One possible manifestation of the orbital contributions is the Sivers effect [1]: a correlation between the transverse momentum direction of partons in the initial state and the transverse spin orientation of the parent proton. We will present the first measurements, from the STAR Collaboration at RHIC, of single spin asymmetries sensitive to the Sivers effect for di-jet production in collisions of transversely polarized proton beams. The data span a wide range in jet pseudorapidity, thereby probing parton transverse momentum preferences in both the valence and (gluon-dominated) sea regions. We will present final results for a sample of 3 million di-jet events from the 2006 RHIC run based on partial jet reconstruction from the electromagnetic calorimeter contribution to jet energies, as recorded online at the trigger level, as well as the status of full offline jet reconstruction incorporating charged-particle tracks. [1] D. Sivers, Phys. Rev. Lett. D41, 83 (1990)

10:00AM CB.00004 ABSTRACT WITHDRAWN —
10:12AM CB.00005 Studies of Spin-Orbit Correlations with Longitudinally Polarized Target at CLAS12, K-AWTAR HAFIDL, Argonne National Laboratory, CLAS COLLABORATION — Azimuthal distributions of final state particles in semi-inclusive deep inelastic scattering (SIDIS) provide access to the orbital motion of quarks and play a key role in the study of transverse momentum dependent (TMD) parton distributions. A comprehensive program to study the transverse momentum dependence of valence-quark transverse and longitudinal spin distributions through measurements of single-spin and double-spin azimuthal asymmetries in the SIDIS of pions using the upgraded JLab 11 GeV polarized electron beam and the CLAS12 detector with longitudinally polarized proton and deuteron targets has recently been proposed. The sin(2θ) azimuthal moment of the target-spin-dependent part of the cross section, in particular, will provide direct information on spin-orbit correlations because the leading twist TMD parton distribution is related to the interference between states with different orbital angular momenta. The pT dependence of the double spin asymmetry will provide information on the transverse momentum dependence of the quark helicity distributions that is complimentary to the single-spin asymmetry measurements.

10:24AM CB.00006 Transvers Quark Spin Effects in Hard Processes, LEONARD GAMBERG, Penn State — The connection between quark orbital angular momentum and final state interaction for transversely polarized quarks in unpolarized hadrons suggests significant cos 2θ azimuthal asymmetries in semi-inclusive deep inelastic scattering (SIDIS), e p → e' X, and in inclusive charged di-hadron production, e+ e− → H H X, as well as in di-lepton production in Drell Yan scattering, p p → ℓ+ ℓ− X. When the transverse momentum of the reaction P_T is on the order of or less than λ_{qcd}, that is where P_T ~ k_T, where k_T is intrinsic transverse quark momentum, these effects are characterized in term of naive time reversal odd (so-called “T-odd”) transverse momentum dependent (TMD) parton distribution and fragmentation functions. At these moderate transverse momentum scales we estimate the size of the cos 2θ azimuthal asymmetry in SIDIS, Drell Yan and e+ e− annihilation, within the parton motivated spectator framework. In SIDIS and Drell Yan scattering we consider this so called “Boer-Mulders” effect for a future experiments at the upgraded CLAS-12 GeV detector at Jefferson LAB and for proton-proton and anti-proton experiments at RHIC, JPARC, and GSI. In e+ e− annihilation, we consider this asymmetry in terms of the Collins effect for kaons at BELLE.

10:36AM CB.00007 Photon-Hadron Correlations in p-p Collisions with the PHENIX Detector, MATTHEW NGUYEN, Brookhaven National Laboratory, PHENIX COLLABORATION — Hard scattering in the γ-jet channel is thought to be a clean observable for energy-loss studies in heavy-ion collisions and spin asymmetries in polarized proton collisions. The measurement of photon-hadron correlations in unpolarized p-p collisions is an important baseline. pQCD calculations describe direct photon production reasonably at in the relevant x_T range, however theoretical uncertainties are non-negligible. Initial and final state radiation present at Next-to-Leading Order may complicate the interpretation of experimental results. Moreover, non-perturbative quantities which influence the yield of photon-hadron pairs, particularly the gluon distribution function and photon fragmentation function, are poorly constrained by the world data in the kinematic range of interest. Photon-hadron correlation data from RHIC at √s_NN = 200 GeV should serve as a benchmark with which to compare data in polarized p-p and nuclear collisions where γ-jet data represent experimental signatures of possible gluon spin effects and Quark-Gluon Plasma formation, respectively. Recent PHENIX data will be presented.

10:48AM CB.00008 Latest HERMES Measurements of Hard Exclusive Processes, STEVE GLISKE, University of Michigan, HERMES COLLABORATION — Hard exclusive processes provide access to the unknown generalized parton distributions (GPDs) which extend our description of the nucleon structure beyond the standard parton distributions. Azimuthal asymmetries in Deeply Virtual Compton Scattering from a transversely-polarized target have been measured for the first time by HERMES. These asymmetries are sensitive to the GPD E which is related via the Ji sum rule to the total angular momentum of quarks within the proton. By comparing these asymmetries with model calculations, model dependent constraints are obtained on J_1 and J_2. Second, the first measurement of the transverse-target spin asymmetry for exclusive π0 production will be shown. This observables provides further access to the GPD E, but a factorization theorem for exclusive meson production has only been proven for longitudinally polarized photons. Fortunately s-channel helicity conservation (SCHC) has been shown to hold well in exclusive ρ0 production. The asymmetry for the production of longitudinally polarized ρ0 mesons was isolated through the angular distribution of the decay products, and assuming SCHC this is equal to the longitudinal-photon asymmetry. The results will be compared with theoretical calculations.

11:00AM CB.00009 k_T Asymmetry in Longitudinally Polarized pp Collisions at PHENIX, DOUGLAS FIELDS, University of New Mexico, PHENIX COLLABORATION — Researchers in the PHENIX experiment at RHIC have developed a method for measuring the average net pair transverse momentum of hard scattered jets at central rapidity. The method is based on the azimuthal correlation between a leading high p_T neutral pion and another charged hadron. The widths of the resulting near- and far-side peaks can then be related to the fragmentation transverse momentum, j_T (the transverse momentum of the fragmented hadron relative to the hard-scattered parton) and the net pair transverse momentum, k_T. The net pair transverse momentum can be produced from parton intrinsic transverse momentum inside the proton, from soft gluon emission, or from next-to-leading order processes of the perturbative QCD. In addition, one could consider the possibility that spin-correlated transverse momentum (orbital angular momentum) may contribute to k_T. Spin-dependent parton transverse momentum adds to k_T an amount dependent upon the helicity combination of the colliding protons, and upon the impact parameter of the collision. However, integration over impact parameter should leave a residual effect that is dependent only on the helicity combination, a signal that is examined in the present data from past RHIC runs.

11:12AM CB.00010 Transverse Spin Dependent Identified Hadron Cross-sections in p↑+p Collisions at √s = 62.4 and 200 GeV, J.H. LEE, FLEMMING VIDEBAEK, Brookhaven National Laboratory, BRAHMS COLLABORATION — Transverse spin dependence of particle production, Single Spin Asymmetries (SSAs), at the energy regime where pQCD is applicable are expected to be negligibly small in the lowest-order QCD approximation, whereas experimentally large SSAs have been observed at high Feynman-x(x_F). Recently, new measurements of SSAs have been available from semi-inclusive deep-inelastic scattering and p↑+p at RHIC providing more insight into the fundamental mechanisms of SSAs as well as the relevant hadron structure. The BRAHMS experiment at RHIC has unique capabilities to explore the high-x_F, kinematic region with particle identification. Measurements of cross-sections and single spin asymmetries of identified charged hadrons, π±, K±, p, and p̅, from transversely polarized proton collisions at √s = 62.4 and 200 GeV are presented. The results are discussed in the context of theoretical models based on pQCD. The energy and flavor dependent SSAs combined with the cross-sections at high-x_F bring new insight into the perturbative Quantum Chromodynamical description of partonic dynamics at RHIC.

11:24AM CB.00011 Transverse Single Spin Asymmetry in p+p Collisions at RHIC, HAN LIU, Los Alamos National Lab, PHENIX COLLABORATION — The measurement of transverse single spin asymmetries(A_N) gives us an opportunity to probe quark and gluon structure of transversely polarized nucleons. PHENIX experiment has collected 2.7 pb^-1 data in transversely polarized p+p collisions at √s=200GeV in 2006 run. At RHIC energy, J/ψ production is dominated by gluon-gluon fusion, thus Collins effect has minimum impact on A_N as the gluon's transversity is zero. Therefore, the measurement of A_N in J/ψ production offers a good opportunity to gain information on gluon's Sivers effect. Results from 2006 for J/ψ A_N at forward rapidity will be presented.

11:36AM CB.00012 ABSTRACT WITHDRAWN
11:48AM CB.00013 Single Transverse Spin Asymmetries in Drell Yan Production at RHIC

LES BLAND, GERRY BUNCE, Brookhaven National Laboratory, MATHIAS GROSSE PERDEKAMP, University of Illinois, MING LIU, Los Alamos National Laboratory, BEAU MEREDITH, University of Illinois, WERNER VOGElsANG, FENG YUAN, Brookhaven National Laboratory — We present the physics and experimental feasibility of single transverse spin asymmetry measurements in Drell Yan di-lepton production in polarized proton-proton collisions at the Relativistic Heavy Ion Collider at Brookhaven National Laboratory. The measurement will be sensitive to Sivers quark distributions and test recent fundamental theory predictions that the Sivers effect will be observed to be process dependent.

12:00PM CB.00014 Transverse single spin asymmetry for dihadron production in polarized \( \sqrt{s} = 200 \text{ GeV} \) pp collisions at PHENIX

RUZiHE YANG, University of Illinois, PHENIX COLLABORATION — Due to the chiral-odd nature of the transverse quark spin distribution functions of the proton, they can only be accessed when coupled to another chiral-odd function such as itself in Drell-Yan, the Collins fragmentation function in inclusive hadron production, or the di-hadron fragmentation function (also called interference fragmentation function) in di-hadron production. Using the PHENIX detector at the Relativistic Heavy Ion Collider (RHIC), the single spin asymmetry of di-hadron production is being studied in transversely polarized proton proton collisions. This single spin asymmetry can be used to extract quark transversity distribution functions with the interference fragmentation function which will be measured in \( e^+ e^- \) collisions by the BELLE detector at KEK. First data for this measurement was collected in 2006, with 2.7 pb\(^{-1}\) integrated luminosity and 57% polarization. The current status of the di-hadron single spin asymmetry will be reported.

Friday, October 12, 2007 9:00AM - 12:00PM
Session CC Electromagnetic Interactions I
Newport News Marriott at City Center Pearl Salon I

9:00AM CC.00001 Exchange currents in light-front quantum models of elastic electron-deuteron scattering

YUNFEI HUANG, WAYNE POLYZOU, The University of Iowa — We present calculations of exchange current contributions to elastic electron-deuteron scattering in a Poincaré invariant quantum model with a light-front kinematic symmetry. Current conservation, current covariance and discrete symmetries can be expressed on either of the elastic current matrix elements in terms of three independent matrix elements of the component of the current. Invariant “impulse approximations” are defined by assuming that there are no two-body contributions to the independent current matrix elements [1]. While the covariance and current conservation constraints generate implicit exchange currents, it is also possible to add explicit exchange current contributions to the independent current matrix elements. We calculate the contribution of model “\( p \bar{p} \) currents” that have an operator structure motivated by exchange currents contributions generated by the Blankenbecler-Sugar reduction of the Bethe-Salpeter equation [2].

1Supported by U.S D.O.E. Grant No. DE-FG02-86ER40286.

9:12AM CC.00002 Deuteron structure studies from electron scattering from vector and tensor polarized deuteron with BLAST

MICHAEL KOHL, M.I.T., BLAST COLLABORATION — The electromagnetic structure of the deuteron is manifest in many polarizability observables accessible by electron scattering in elastic, quasielastic, and pion production kinematics which have been measured simultaneously with the BLAST experiment at MIT-Bates. The deuteron’s quadrupole moment and associated nonspherical shape give rise to elastic tensor analyzing powers and vector correlation parameters. Electrodisintegration in the quasielastic regime allows for a systematic study of final state interaction, meson exchange and relativistic effects. Pion electroproduction from tensor-polarized deuteron is well suited to probe effects due to the two-nucleon singlet-S state. This talk will discuss the current status of the data analysis and present preliminary results.

1Work supported by the United States Department of Energy under Cooperative Agreement DE-FG02-94ER40818.

9:24AM CC.00003 New Measurement of Elastic ed Scattering

BYUNGWUEK LEE, SEONHO CHOI, Seoul National University, DOUGLAS HIGGINBOTHAM, Jefferson Lab, RONALD GILMAN, Rutgers University, FOR THE JEFFERSON LAB HALL A COLLABORATION — Differences between previous high-precision measurements of elastic deuteron elastic scattering prevent a clear determination of even the sign of the leading low-momentum transfer relativistic corrections, or of the chiral-odd, vector current contributions to the independent current matrix elements. We calculate the contribution of model “\( p \bar{p} \) currents” that have an operator structure motivated by exchange currents contributions generated by the Blankenbecler-Sugar reduction of the Bethe-Salpeter equation [2].


9:36AM CC.00004 Nucleon Polarisabilities from Deuteron Compton Scattering, and Its Lessons for Chiral Counting

HARALD W. GRIESSHAMMER, Department of Physics, George Washington University — Chiral Effective Field Theory with explicit \( \Delta(1232) \) degree of freedom is for photon energies up to 300 MeV the tool to accurately determine the proton and neutron polarizabilities from Compton scattering in a model-independent and systematic way. It proves in particular indispensable to understand deuteron Compton scattering at 95 MeV as measured at SAL. Simple consistency arguments derived from nuclear phenomenology lead for the deuteron to the correct Thomson limit, demonstrating gauge-invariance and shedding new light on Weinberg264s proposed power-counting of nuclear forces. In our global analysis of all elastic proton and deuteron Compton scattering up to 150 MeV, we find for the static scalar dipole polarizabilities \( \delta^p = (11.0 \pm 1.4_{\text{stat}} \pm 0.4_{\text{syst}}) \times 10^{-4} \text{ fm}^3 \), \( \delta^n = (28.8 \pm 1.4_{\text{stat}} \pm 0.4_{\text{syst}}) \times 10^{-4} \text{ fm}^3 \) for the proton and \( \delta^p = (11.6 \pm 1.5_{\text{stat}} \pm 0.6_{\text{syst}}) \times 10^{-4} \text{ fm}^3 \), \( \delta^n = (3.6 \pm 1.5_{\text{stat}} \pm 0.6_{\text{syst}}) \times 10^{-4} \text{ fm}^3 \) for the deuteron. Thus, proton and neutron polarizabilities are identical within the accuracy of available data. New experiments e.g. at MAXlab (Lund) will improve the statistical error-bar.


9:48AM CC.00005 The \( D(e,e'p) \) reaction at GeV energies

SABINE JESCHONNEK, The Ohio State University at Lima, J. WALLACE VAN ORDEN, Old Dominion University & Jefferson Lab — Currently, several data sets on \( D(e,e'p) \) reactions, taken at Jefferson Lab, are analyzed or have been published recently. A solid theoretical description is necessary in order to understand these data and extract all possible information, both on the reaction mechanism and the nuclear ground state. Final state interactions and relativistic treatment of the current operator are essential. We present the results of a new calculation with a relativistic wave function for the initial deuteron state. We will discuss the sensitivity of various observables to the employed parametrization of the nucleon-nucleon scattering amplitude in the final state, and investigate several observables at high missing momentum.

1Supported in part by NSF PHY 0354916 and DOE DE-AC05-84ER40150.
10:00AM CC.00006 Induced Polarization in $^4\text{He}(e,e'p)$\,$^3\text{H}$, SIMONA MALACÉ, University of South Carolina, HALL A COLLABORATION — The transferred polarization in the $^4\text{He}(e,e'p)$\,$^3\text{H}$ reaction at $Q^2$ values of 0.4, 0.5, 1.0, 1.6, and 2.6 GeV$^2$ have been measured to study possible medium modifications of the proton form factors. Our preliminary results indicate an induced polarization of about 0.3% more light on this controversy. Even more, a precise knowledge of the induced polarization will allow improvement of the FSI treatment by providing additional experimental constraints to existing theoretical calculations. In our follow-up experiment E03-104 at JLab high statistics data were taken at a $Q^2$ of 0.8 GeV$^2$ and 1.3 GeV$^2$ on $^1\text{H}$ and $^4\text{He}$ targets. The extraction of the small induced polarization is complicated by the possible presence of instrumental asymmetries in the focal-plane polarimeter. The induced polarization in the elastic $^4\text{He}(e,e'p)$ reaction is (in one-photon approximation) zero and provides crucial information about these false asymmetries. Our preliminary results indicate an induced polarization of about −0.03 and seem to be in reasonable agreement with the RDWIA calculation of Udas \textit{et al}.\footnote{Work supported in part by NSF PHY-0555604.}

10:12AM CC.00007 Polarization Transfer in $^4\text{He}(e,e'p)$\,$^3\text{H}$, MICHAEL PAOLONI\textsuperscript{1}, University of South Carolina, JEFFERSON LAB HALL A COLLABORATION — Polarization transfer in quasi-elastic nucleon knockout is sensitive to the properties of the nucleon in the nuclear medium, including possible modification of the nucleon form factor and/or spinor. In our recently completed experiment E03-104 at Jefferson Lab we measured the proton recoil polarization in the $^4\text{He}(e,e'p)$\,$^3\text{H}$ reaction at a $Q^2$ of 0.8 (GeV/c)$^2$ and 1.3 (GeV/c)$^2$ with unprecedented precision. These data complement earlier data between 0.4 and 2.6 (GeV/c)$^2$ from both Mainz and Jefferson Lab, in which the measured ratio of polarization-transfer coefficients differs from a fully relativistic DWIA calculation. The earlier polarization-transfer data are equally well described by the inclusion of a medium modification of the proton form factors predicted by a quark-meson coupling model and by a recent calculation including, particularly, a spin-dependent charge exchange in the final-state interaction. However, the preliminary analysis of our present data possibly implies an unexpected $Q^2$ dependence of the ratio of polarization-transfer coefficients. Due to its high statistical precision the new data allow for a detailed study of the missing momentum dependence of individual polarization-transfer coefficients in the $^4\text{He}(e,e'p)$\,$^3\text{H}$ reaction. Final results will be discussed.\footnote{Work Supported in part by NSF PHY-0555604.}

10:24AM CC.00008 Double-Coincidence $^{12}\text{C}(e,e'p)$ in a Correlations Dominant Regime, PETER MONAGHAN, MIT, E01-015 COLLABORATION, JEFFERSON LAB HALL A COLLABORATION — We performed an experiment to investigate short-range correlations in carbon via a triple-coincidence $(e,e'pN)$ reaction in Hall A at Jefferson Lab. As a natural consequence of studying the three-body reaction, we collected high-quality double-coincidence $(e,e'p)$ data, which are presented here. Our kinematics were chosen with $Q^2 = 2$ (GeV/c)$^2$ and $x_H > 1$ to provide a regime in which short-range correlations are expected to dominate the initial state; thus, the electrons were scattering primarily off nucleon pairs. The resulting $(e,e'p)$ data were obtained over a high missing-momentum region, $P_{cm} \sim 200 – 600$ MeV/c. We present the cross-section data for the bound-state reaction $^{12}\text{C}(e,e'p)\,^{11}\text{B}$ and also for scattering to the continuum from carbon, and compare our results to relativistic theoretical calculations.

10:36AM CC.00009 Short-Range Correlations in $^{12}\text{C}(e,e'pN)$, RAMESH SUBEDI, Kent State University, JEFFERSON LAB E01-015 COLLABORATION, JEFFERSON LAB HALL A COLLABORATION — Correlations in nuclei, i.e., deviations from independent-particle behaviour, are generally classified into two types: long-range correlations due to the long-range, attractive part of the nucleon-nucleon interaction, and short-range correlations dominated by the short-range, repulsive part of the nucleon-nucleon interaction. We made direct observation of short-range correlated NN-pairs using the exclusive $^{12}\text{C}(e,e'pN)$ reaction in a triple-coincidence measurement in the experiment E01-015 in Hall A at Jefferson Lab. We will present results from our analysis of the $^{12}\text{C}(e,e'pN)$ reaction. From this analysis we conclude that there are nearly 20 times more n-p short-range correlated pairs than p-p short-range correlated pairs.

10:48AM CC.00010 Cross sections for the $(e,e'p)$ reactions for $^{208}\text{Pb}$ and $^{209}\text{Bi}$ at high momentum transfer measured at Jefferson Lab, JUAN CARLOS CORNEJO, Cal. State Univ., Los Angeles, JOAQUIN LOPEZ HERRAIZ, Univ. Complutense de Madrid, JEFFERSON LAB HALL A COLLABORATION — The reactions $^{208}\text{Pb}(e,e'p)^{207}\text{Tl}$ and $^{209}\text{Bi}(e,e'p)^{208}\text{Pb}$ have recently been measured at Jefferson Lab in fixed quasielastic kinematics, $q=1$ GeV/c, $\omega = 0.433$ GeV, $Q^2 = 0.81$ GeV$^2$. This is the first time that these reactions have been measured for $x_g = 1$, a condition which allows for a relatively unambiguous identification of long range correlations affecting the occupancy probability of the valence single nucleon states. Cross sections were measured symmetrically on both sides of the three momentum transfer from 0 to 500 MeV/c in missing momentum for $^{208}\text{Pb}$ and from 100 MeV/c to 300 MeV/c in $^{209}\text{Bi}$. The low lying states in $^{207}\text{Tl}$ are the focus of this study using the high resolution spectrometers of Hall A. Results for the $^{209}\text{Bi}(e,e'p)^{208}\text{Pb}$ will also be shown. In the range of missing momenta $< 300$ MeV/c a complex structure in the cross section asymmetry, $A_{TLL}$, is predicted within the impulse approximation.

11:00AM CC.00011 Relativistic models for the $(e,e'p)$ reaction on $^{208}\text{Pb}$, JOAQUIN LOPEZ HERRAIZ, Univ. Complutense de Madrid, JUAN CARLOS CORNEJO, Cal. State Univ., Los Angeles, JEFFERSON LAB HALL A COLLABORATION — $^{209}\text{Pb}$ is the nucleus that one would pick as the best testing tool of the shell model. That’s why it has been extensively explored in the past, for example, by means of the $(e,e'p)$ reaction. Jefferson Lab is ideally suited to perform $(e,e'p)$ reactions and recently the $(e,e'p)$ reaction on lead has been measured for the first time at this facility. We attempt to determine spectroscopic factors by comparing high statistics, quasielastic data for cross-sections at several q values to relativistic mean field predictions, over a wide range of missing momentum. The $A_{TLL}$ cross section asymmetry predictions from these relativistic models will also be compared to the data measured in fixed quasielastic kinematics, $q=1$ GeV/c, $\omega = 0.433$ GeV, $Q^2 = 0.81$ GeV$^2$ at Jefferson Lab. Relativistic mean field calculations predict values of $A_{TLL}$ that deviate substantially from the predictions that do not include the enhancement of the lower component of the wave function due to dynamical relativistic effects. The role played by correlations in the high missing momentum region of the $(e,e'p)$ reaction is expected to be disentangled.

11:12AM CC.00012 Spectrometer optics studies and target development for the $^{208}\text{Pb}(e,e'p)$ experiment in Hall A at Jefferson Lab, GUIDO M. URCIUOLI, INFN, Roma, Italy, JUAN CARLOS CORNEJO, Cal. State Univ., Los Angeles, JOAQUIN LOPEZ HERRAIZ, Univ. Complutense de Madrid, JEFFERSON LAB HALL A COLLABORATION — The reactions $^{208}\text{Pb}(e,e'p)^{207}\text{Tl}$ and $^{209}\text{Bi}(e,e'p)^{208}\text{Pb}$ have recently been measured at Jefferson Lab using the high resolution spectrometers of Hall A. Monte Carlo simulations of these reactions showed that with a missing energy resolution of 1 MeV, spectrum fitting techniques could extract the cross sections for the states of $^{207}\text{Tl}$ up to 3.5 MeV excitation. Extensive spectrometer optics studies were required to attempt to achieve the requisite missing energy resolution. In addition, the low melting temperature of the heavy metal targets required rastering the electron beam spot on the target and a special target holder to be employed. The measurement was possible because of the unique electron beam characteristics of CEBAF, the high resolution spectrometers of Hall A and the use of a novel target design which allowed for up to 80 $\mu$m of beam target. The experimental challenges and procedures will be discussed.
Neutron-Proton Bremsstrahlung; with explicit correction terms at 225 MeV\(^1\)

11:00AM CC.00004 The NPDGamma Experiment; Data and Preliminary Results from the LANSCE phase, MIKAYEL DABAGHYAN, University of New Hampshire, NPDGAMMA COLLABORATION — The NPDGamma experiment is measuring the directional parity violating asymmetry in the emission of gamma rays from the capture of cold neutrons on protons. The asymmetry can be measured using neutrons in a straightforward way to effective couplings within an appropriate NN weak interaction theory, such as chiral perturbation based effective field theories. Since this is a measurement within a two body system, the observables are calculable without uncertainties from few to many body (large nuclei) effects. The experiment consists of two phases. The first one, at the Los Alamos Neutron Science Center (LANSCE), has just been completed, providing a measurement of the asymmetry to an accuracy at the \(10^{-6}\) level. The second phase of the experiment will commence at the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory in April 2006 and is in the process of ramping up to full operational capacity. The SNS Source (SNS) at Oak Ridge National Laboratory initiate operations in April 2006 and is in the process of ramping up to full operational capacity. The SNS.

Since this is a measurement within a two body system, the observables are calculable without uncertainties from few to many body (large nuclei) effects. The experiment consists of two phases. The first one, at the Los Alamos Neutron Science Center (LANSCE), has just been completed, providing a measurement of the asymmetry to an accuracy at the \(10^{-6}\) level. The second phase of the experiment will commence at the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory in April 2006 and is in the process of ramping up to full operational capacity. The SNS Source (SNS) at Oak Ridge National Laboratory initiate operations in April 2006 and is in the process of ramping up to full operational capacity. The SNS.

\(^1\)Work supported by the United States Department of Energy under Cooperative Agreement DE-FC02-94ER40818.

References

11:36AM CC.00014 Nucleon form factors and charge densities from the BLAST Experiment\(^1\)

CHRIS CRAWFORD, University of Kentucky, BLAST COLLABORATION — The BLAST experiment was designed to study in a systematic manner the spin-dependent electromagnetic interaction. Utilizing the polarized electron beam in the MIT-Bates South Hall Storage Ring, highly-polarized isotopically pure targets of hydrogen and deuterium, and the symmetric general purpose BLAST detector; precise measurements have been made which permit the extraction of the proton and neutron charge and magnetic form factors. The neutron electric form factor especially is now known to a precision comparable to that of the other nucleon form factors. These results, together with previously existing data, will constrain theoretical models constructed to explain the detailed structure of nucleon form factors.

\(^1\)DOE

11:48AM CC.00015 A measurement of two-photon exchange in unpolarized elastic electron-proton scattering, JAMES JOHNSON, Northwestern University, JEFFERSON LAB E05-017 COLLABORATION — Inconsistency between the measurements of the proton elastic form factors using recoil polarization and precision Rosenbluth separations suggests the presence of a two-photon exchange term. We look for the effects of two-photon exchange on electron-proton elastic scattering through both precision comparisons of cross section and recoil polarization measurements, and mapping nonlinearities in the reduced cross section with respect to the virtual photon longitudinal polarization. We achieve the necessary sensitivity using a modified Rosenbluth method. By detecting protons instead of electrons, we reduce the variation in the cross section as well as the magnitude of the radiative corrections. We have taken measurements between 0.6 and 5.74 \(Q^2\), sensitive to the nonlinear portion of two-photon exchange at the low end and the full two photon effect at the high end. We will present initial results, and show the sensitivity we hope to obtain in the final measurement.

9:00AM CD.00001 Fundamental Neutron Physics: an Overview, CHEN-YU LIU, Indiana University — Experiments using neutrons have been used to refine our understanding of the weak interaction. These include measurements of neutron beta-decay observables and parity violating nucleon-nucleon interactions. Precision measurements using low energy neutrons are also useful in the search for new physics beyond the Standard Model. I will discuss some new and ongoing research in this field.

9:36AM CD.00002 Status of the Fundamental Neutron Physics Beamline at the Spallation Neutron Source, GEOFFREY GREENE, University of Tennessee, VINCE CIANCIOLI, RICHARD ALLEN, Oak Ridge National Laboratory, PAUL HUFFMAN, North Carolina State, W. MICHAEL SNOW, Indiana University, TAKEYASU ITO, Los Alamos National Laboratory — The Spallation Neutron Source (SNS) at Oak Ridge National Laboratory initiate operations in April 2006 and is in the process of ramping up to full operational capacity. The SNS has dedicated one of its cold neutron beamlines for nuclear and particle physics research. This Fundamental Neutron Physics Beamline (FNPB) is scheduled to commence operations in 2008. The anticipated research program at the FNPB includes studies of neutron beta decay and the hadronic weak interaction as well as a search for a neutron electric dipole moment. The talk will give an overview of the FNPB project, a construction status update, and a description of the initial, anticipated, suite of measurements.

9:48AM CD.00003 ABSTRACT WITHDRAWN —

10:00AM CD.00004 The NPDGamma Experiment; Data and Preliminary Results from the LANSCE phase, MIKAYEL DABAGHYAN, University of New Hampshire, NPDGAMMA COLLABORATION — The NPDGamma experiment is measuring the directional parity violating asymmetry in the emission of gamma rays from the capture of cold neutrons on protons. The asymmetry can be measured using neutrons in a straightforward way to effective couplings within an appropriate NN weak interaction theory, such as chiral perturbation based effective field theories. Since this is a measurement within a two body system, the observables are calculable without uncertainties from few to many body (large nuclei) effects. The experiment consists of two phases. The first one, at the Los Alamos Neutron Science Center (LANSCE), has just been completed, providing a measurement of the asymmetry to an accuracy at the \(10^{-7}\) level. The second phase of the experiment will commence at the Spallation Neutron Source at Oak Ridge, where it is currently being reassembled, to continue the measurement to an accuracy at the \(10^{-8}\) level. On behalf of the NPDGamma collaboration, I will present a brief overview of the LANSCE phase of the experiment, including the layout and a report on the data analysis and some preliminary results.

10:12AM CD.00005 The NPDGamma Experiment at the SNS FpPB, CHRISTOPHER CRAWFORD, University of Tennessee, NPDGAMMA COLLABORATION — The NPDGamma experiment recently concluded a successful first phase data-taking run at LANSCE and is now moved to ORNL where it has been approved to run as the first experiment at the Fundamental Neutron Physics Beamline at the SNS. To accommodate the SNS beam and lessons learned at LANSCE, a number of changes have been proposed for the experiment. I will describe these improvements and upgrades, and the expected performance of the experiment to measure the parity-violating directional gamma asymmetry \(A_\gamma\) of the reaction \(n+p\rightarrow d+\gamma\) with an error of \(1\times 10^{-8}\).
10:24AM CD.00006 The Parity Violating Longitudinal Asymmetry in the capture of Cold Neutrons on $^3$He. , MICHAEL GERICE, University of Manitoba, J. DAVID BOWMAN, Oak Ridge National Laboratory, CHRISTOPHER CRAWFORD, University of Kentucky, SEPPO PENTTILA, Oak Ridge National Laboratory, W. MICHAEL SNOW, Indiana University — Within the framework of sPT based effective field theory models the nucleon-nucleon (NN) weak interaction is described in terms of various effective coupling constants, of which there are at least 4 but generally up to 15 without the application of cutoffs. There are few possible parity violating NN experiments that could constrain or test the predicted coupling strengths and they are often very challenging to implement. We have analyzed the feasibility of a new experiment which would measure the parity violating longitudinal asymmetry in cold neutron capture on an unpolarized $^3$He target. The great advantage of this experiment would be that there are only a handful of components needed and that these employ common, well known technologies without the need for lengthy R&D. We will present a reference design and run time estimate as well as an analysis of systematic effects to show that this would be a feasible experiment which could run at the Spallation Neutron Source, Oak Ridge.

10:36AM CD.00007 Measurement in progress of the parity-violating neutron spin-rotation in liquid $^4$He$^1$, D.M. MARKOFF, NC Central Univ./TUNL, C.D. BASS, J.M. DAWKINS, T.D. FINLEY, J.C. HORTON, C.R. HUFFER, D. LUO, M.G. SARSOUR, W.M. SNOW, Indiana Univ./UCF, K. GAN, A.K. OPPER, The George Washington Univ., A.M. MICHERDZINSKA, The Univ. of Winnipeg, B.R. HECKEL, H.E. SWANSON, Univ. of Washington, H.P. MUMM, J.S. NICO, NIST, B.E. CRAWFORD, Gettyburg College, E.I. SHARAPOV, JINR — As part of a program to characterize the low-energy, weak hadronic interaction, an experiment is in progress at the NIST Center for Neutron Research to measure the parity-violating neutron spin-rotation observable in the $n$-$\alpha$ system. The apparatus is designed to measure the rotation of the transverse polarization vector of long-wavelength neutrons as they traverse the helium target with a sensitivity of $3 \times 10^{-7}$ rad/m. To reach this goal, we have worked towards reducing systematic effects from background magnetic fields and neutron scattering and through understanding the apparatus and beam. We developed the helium target system to reduce the effects of neutron scattering and to increase operational reliability. We initiated a series of measurements in solid targets with known large or negligible parity-violating signals to study systematics from the polarimeter. The apparatus and experiment status will be presented.

1Work supported in part by NSF grant PHY-0457219.

10:48AM CD.00008 Proposed measurement of the neutron spin-rotation through solid ortho-deuterium. , A. KOMIVES, De Pauw Univ., D.M. MARKOFF, B.J. CROWE, NC Central Univ. — In recent review papers [1,2] a program to study parity-violating (PV) nucleon-nucleon (NN) interaction observables including spin-rotation in the $n$-$\alpha$ and $n$-$\bar{p}$ systems has been proposed to characterize the weak NN interaction. The rotation of the transverse neutron polarization vector as the long-wavelength neutron traverses the medium, results from the PV weak forward scattering amplitude. We propose that the spin-rotation observable in the $n$-$\bar{d}$ system would greatly contribute to this experimental and theoretical effort. Neutron depolarization from a relative large scattering cross section of a few barns in the deuteron could greatly dilute the small rotation signal on the order of $10^{-7}$ radians. Recent measurements were performed at the FUNSPIN beam line at the Paul Scherrer Institute of the depolarization of neutrons transmitted through liquid and solid ortho-deuterium as a function of neutron energy [3]. Results indicate that the observed depolarization of cold neutrons through solid ortho-deuterium is low enough for a measurement of the neutron spin-rotation to be feasible. We present here a proposed apparatus and program to measure the neutron spin-rotation through the $\bar{n}$-$d$ system.


11:00AM CD.00009 Measuring the Neutron Lifetime Using Magnetically Trapped Ultracold Neutrons. , CHRISTOPHER O'SHAUGHNESSY, North Carolina State University, KEVIN COAKLEY, National Institute of Standards and Technology, JOHN DOYLE, Harvard University, ROBERT GOLUB, PAUL HUFFMAN, EKATERINA KOROBKINA, North Carolina State University, STEVE LAMOREAUX, Yale University, HANS MUMM, University of Maryland, KARL SCHELHAMMER, PIL-NEO SEO, CHRISTOPHER SWANK, North Carolina State University, ALAN THOMPSON, GRACE YANG, National Institute of Standards and Technology, LIANG YANG$^1$, Harvard University — The neutron lifetime is an important parameter for tests of standard model and big bang nucleosynthesis. Our collaboration has successfully demonstrated the feasibility of using magnetically trapped ultracold neutrons for this measurement. In this experiment ultracold neutrons are loaded into an Ioffe-type superconducting magnetic trap as they are produced through the superthermal technique in superfluid helium-3. Trapped neutrons are then detected via scintillation light of liquid helium due to the decay events. The advantages of this technique are the continuous detection of the decay events and the elimination of trap losses due to interactions with a material wall. Current work is aimed at upgrading the experiment to include a larger and deeper magnetic trap. This is expected to reduce the statistical uncertainties to 1-3 s. Here the apparatus upgrades will be discussed.

$^1$Current Address SLAC

11:12AM CD.00010 Measuring the Spin-Dependent Scattering Length of $^3$He using Neutron Interferometry. , M. HUBER, F.E. WIETFELDT, Tulane University, M. ARIF, T.R. GENTILE, W. CHEN, D. PUSHLIN, L. LANG, NIST, T. BLACK, UNC Wilmington. — Experimental measurements of neutron scattering lengths are only recently achieving the required accuracy to test nucleon-nucleon (N-N) models. Neutron Interferometry (NI) provides some of the most precise values of spin-independent neutron scattering lengths including percent or better measurements for n-H, n-D, and n-$^3$He. For $^3$He, the spin-dependent neutron scattering length, $b_1$, has been measured once before by Zimmer et al. [1] using a polarized $^3$He target inside a spin echo apparatus. Their result $b_1 = -2.365(20)$ differs from various theoretical models by more than 4σ. Currently, we are conducting an experiment to measure $b_1$ for $^3$He to better than half a percent at the NI and Optics Facility at the National Institute of Standards and Technology (NIST) using a small, flat-windowed gas cell containing polarized $^3$He. This is the first use of a polarized gas target in a NI. Results from this experiment will be presented. This work is supported by the National Science Foundation and NIST.


11:24AM CD.00011 An Apparatus for Absolute Neutron Flux Measurement. , A. YUE, The University of Tennessee - Knoxville, G. GREENE, The University of Tennessee - Knoxville / Oak Ridge National Laboratory, M.S. DEWEY, D. GILLIAM, J. NICO, National Institute of Standards and Technology, A. LAPTEV, Tulane University — A fully-absorbing neutron detector is being developed to measure the absolute flux ($s^{-1}$) of a cold neutron beam at the level of 0.1%. The device will be used to calibrate a neutron flux monitor used in an in-beam neutron lifetime measurement performed at NIST ($\tau_{n,\alpha} = (886.5 \pm 1.1) s$). The precision of the measurement was limited by the uncertainty in the efficiency of the neutron flux monitor (0.3%). The flux monitor operates by counting charged particles produced when neutrons impinge on a $^6$Li (or $^{10}$B) foil. Its efficiency was calculated from the cross section, the solid angle subtended by the charged particle detectors, and the amount of neutron-absorbing material present on the foil. Successful calibration would reduce the neutron lifetime uncertainty to approximately 0.25%. In addition, using the measured solid angle and amount of material on the deposit, a new experimental value for the $^6$Li (or $^{10}$B) capture cross section will be obtained. Details of the apparatus and the measurement technique along with the status of the experiment will be discussed.
11:36AM CD.00012 Precision Polarimetry for Cold Neutrons, LIBERTAD BARRON-PALOS, Arizona State University, J. DAVID BOWMAN, Oak Ridge National Laboratory, TIMOTHY E. CHUPP, University of Michigan Ann Arbor, CHRISTOPHER CRAWFORD, University of Tennessee, AREG DANAGOUlian, Los Alamos National Laboratory, THOMAS R. GENTILE, National Institute of Standards and Technology, GORDON JONES, Hamilton College, ANDREAS KLEIN, Los Alamos National Laboratory, SEPPPO I. PENTTILA, Oak Ridge National Laboratory, AMERICO SALAS-BCCI, Los Alamos National Laboratory, MONISHA SHARMA, University of Michigan Ann Arbor, W. SCOTT WILBURN, Los Alamos National Laboratory — The aBBA and PANDA experiments, currently under development, aim to measure the correlation coefficients in the polarized free neutron beta decay at the FNbP in SNS. The polarization of the neutron beam, polarized with a 3He spin filter, has to be known with high precision in order to achieve the goal accuracy of these experiments. In the NPDGamma experiment, where a 4He spin filter was used, it was observed that backgrounds play an important role in the precision to which the polarization can be determined. An experiment that focuses on the reduction of background sources to establish techniques and find the upper limit for the polarization accuracy with these spin filters is currently in progress at LANSE. A description of the measurement and results will be presented.

11:48AM CE.00013 A Study of the Effect of Neutron Beam on 3He Spin Filters, MONISHA SHARMA, University of Michigan Ann Arbor, LIBERTAD BARRON-PALOS, Arizona State University, TIMOTHY E. CHUPP, University of Michigan Ann Arbor, CHRISTOPHER CRAWFORD, University of Tennessee, AREG DANAGOUlian, Los Alamos National Laboratory, THOMAS R. GENTILE, National Institute of Standards and Technology, GORDON JONES, Hamilton College, ANDREAS KLEIN, Los Alamos National Laboratory, BERNHARD LAUSS, Institut Laue-Langevin, SEPPPO I. PENTTILA, Oak Ridge National Laboratory, TODD B. SMITH, University of Dayton, ERIC TARDIFF, University of Michigan Ann Arbor, W. SCOTT WILBURN, Los Alamos National Laboratory — A polarized 3He neutron spin filter has been used for the NPDGamma experiment at the FP12 beamline at LANSE. During the experiment we observed a new, but currently unexplained effect of the neutron beam on the 3He polarization, leading to reductions of the 3He polarization of several percent. This effect is consistent with a rapid reduction of the average rubidium polarization, but could also be due to a reduction of the 3He relaxation rate. It is not known how the effect scales with neutron flux or flux density. Systematic studies of 3He and 4He polarization in the neutron beam are currently underway at LANSE and the progress towards the understanding of this effect will be reported.

Friday, October 12, 2007 9:00AM - 12:12PM – Session CE Heavy Ions and Rare Isotope Beams Newport News Marriott at City Center Grand Salon V

9:00AM CE.00001 Improved Mass Measurements of Nuclei Around N = Z = 34 and The First High Precision Mass Measurement of 70(9)Br*(1). J. SAVORY, C. BACHELET, M. BLOCK, G. BOLLEN, M. FACINA, C.M. FOLDEN III, G. GUENAUT, E. KWAN, A.A. KWIATKOWSKI, D.J. MORRISSEY, G.K. PANG, A. PRINKE, R. RINGLE, H. SCHATZ, S. SCHWARZ, P. SCHURY, C.S. SUMITHRARACHCHI, National Superconducting Cyclotron Laboratory, Michigan State University, Michigan — Mass measurements of N = Z nuclei are important for the study of symmetries in nuclear structure, modeling of element synthesis in the rp-process and fundamental interactions tests. Heavy N = Z are located close to or even beyond the proton drip line. The Low Energy Beam and Ion Trap (LEBIT) facility succeeded in making the first high precision mass measurement of 70(9)Br, an N = Z proton drip line nucleus. In addition to 70(9)Br, the masses of 71Br, 76Se and 69Se were measured by Penning trap mass spectrometry of thermally rare isotopes produced by fast-beam fragmentation. The results indicate that 69Se poses a greater waiting point in the rp-process, than previously thought.

1This work was done with the support of Michigan State University, the National Science Foundation Grant PHY-0110253 and the US Department of Energy Contract DE-FG02-00ER41144.

9:12AM CE.00002 Identifying spins and configurations of states in 13B, A.H. WUOSMAA, J.C. LIGHTHALL, S.T. MARLEY, Western Michigan University, J.P. SCHIFFER, C.L. JIANG, H.Y. LEE, M. NOTANI, R.C. PARDO, K.E. REHM, I. TANIHATA, Argonne National Laboratory, X.D. TANG, University of Notre Dame, N. PATEL, Colorado School of Mines — The 12B(d,p)13B reaction has been studied for the first time, in an effort to narrow down the spin and parity assignments of the excited states states in this nucleus. The particular aim of the measurement is to establish the odd-parity states arising from s(2)2. In addition to 70(9)Br, the masses of 71Br, 76Se and 69Se were measured by Penning trap mass spectrometry of thermally rare isotopes produced by fast-beam fragmentation. The results indicate that 69Se poses a greater waiting point in the rp-process, than previously thought.

9:24AM CE.00003 First Discovery of an Isomeric State with a Penning Trap Mass Spectrometer, A.A. KWIATKOWSKI, M. BLOCK, C. BACHELET, G. BOLLEN, M. FACINA, C.M. FOLDEN III, C. GUENAUT, D.J. MORRISSEY, G.K. PANG, A. PRINKE, R. RINGLE, J. SAVORY, P. SCHURY, S. SCHWARZ, National Superconducting Cyclotron Laboratory, Michigan State University — An isomeric state of 90Fe has been discovered at the Low Energy Beam and Ion Trap facility (LEBIT) at the NSCL. From its measured mass difference with the ground state, the new isomer is determined to have an excitation energy of 402(5) keV. Following the systematics of spin and energy levels of lighter isotopes, tentative spin assignments were made for the ground state and the observed isomer. In addition to 63Fe, high-precision mass measurements were made of 64,64Fe and 64–66Co using the Penning trap mass spectrometer. The mass uncertainties of all isotopes have been reduced by a factor of 10-100 compared to previous experiments. Moreover, our measurement of 64Co differs from the accepted value by about five standard deviations. One motivation for mass measurements in this region is the observed N=40 shell closure.

1This work has been supported by Michigan State University; the NSF under contract number PHY-0110253, and the DOE under the contract DE-FG02-00ER41144.

9:36AM CE.00004 Observation of new neutron-rich Mg, Al, and Si isotopes, T. BAUMANN, A.M. AMTHOR, D. BAZIN, C.M. FOLDEN III, A. GADE, T.N. GINTER, M. HAUSMANN, M. MATOS, D.J. MORRISSEY, A. NETTLETON, M. PORTILLO, A. SCHILLER, B.M. SHERRILL, A. STOLZ, O.B. TARASOV, M. THOENENNENJN, Michigan State University, East Lansing, MI 48824-1321 — We report on the first observation of the neutron-rich isotopes 48Mg, 42,43Al, and 44Si. The rare isotopes were produced by fragmentation of 58Ca at 142 MeV/u at NSCL using tungsten targets, and subsequently separated in the A1900 fragment separator. For the discovery of 48Mg and 42,43Al, the A1900 was used in combination with the S800 analysis beam line, resulting in an exceptional selectivity. The comparison of the observed isotopes—especially the odd-odd 42Al—to established theoretical model calculations suggests that the dip line lies further out to heavier isotopes, at least for aluminum and silicon.

1Supported by the National Science Foundation under grant PHY-06-06007.

2Present Address: Ohio University, Athens, OH 45701.
Constraining the density dependence of the symmetry energy and the Nuclear equation of state: A dynamical and statistical model approach

9:48AM CE.00005

D.V. SHETTY, S.J. YENNELLO, G.A. SOULIOTIS, Cyclotron Institute, Texas A&M University — The density dependence of the symmetry energy is important for studying the equation of state of systems as diverse as the atomic nuclei and neutron stars. Our current understanding of this very important quantity remains largely unconstrained due to a lack of understanding of the basic nuclear-nucleon interaction for matter that is highly asymmetric and at non-normal nuclear density. Theoretical studies based on microscopic "ab-initio" calculations predict variety of different form of the density dependence of the symmetry energy. Recent studies carried out at Texas A&M University to investigate the equation of state of isospin asymmetric nuclear matter using the statistical and the dynamical model approaches of multifragmentation reaction will be presented. These studies along with several other independent studies rule out an extremely "stiff" and "soft" form of the density dependence of the symmetry energy and have important implications for astrophysical and nuclear physics studies. The importance of further constraints for studying the symmetry energy of finite nuclei will also be emphasized.

1Work supported by Robert A. Welch foundation (grant no A-1266) and the DOE (grant no DE-FG03-93ER40773).

10:00AM CE.00006

The single-particle states in $^{135}$Sn studied through the $^{132}$Sn (d,p) reaction

KATE JONES, University of Tennessee, JOLIE CIZEWSKI, Rutgers University, ORRUBA / RIBENS COLLABORATION — It is important, both to nuclear structure physics and to understanding the synthesis of heavy elements in the cosmos, to understand how single-particle states change as we move away from the valley of stability, especially around shell closures. A beam of $^{132}$Sn, produced at ORNL's Holifield Radioactive Ion Beam Facility, was used in a transfer reaction experiment to study single-particle states beyond the double-shell closure. The beam impinged on a target of Cd, with effective thickness of 160g/cm². Charged ejectiles were detected in an array of position sensitive silicon detectors, mostly of the new ORRUBA type, with SIDAR detectors at very backward angles. At forward laboratory angles, telescopes of detectors were used to discriminate protons from heavier, elastically scattered particles. From the angles and Charged ejectiles were detected in an array of position sensitive silicon detectors, mostly of the new ORRUBA type, with SIDAR detectors at very backward angles. At forward laboratory angles, telescopes of detectors were used to discriminate protons from heavier, elastically scattered particles. From the angles and

1This work was supported in part by the US DOE and the NSF.

10:12AM CE.00007

Fusion of $^{134}$Sn, $^{134}$Sb and $^{134}$Te with $^{64}$Ni at near and subbarrier energies

DAN SHAPIRA, J.F. LIANG, C.J. GROSS, R.L. VARNER, J.R. BEENE, P.E. MUELLER, D.W. STRACENER, Physics Division, Oak Ridge National Lab, W. LOVELAND, Dept. of Chemistry, Oregon State Univ., J.J. KOLATA, H. AMRO, A. ROBERTS, Dept. of Physics & Astronomy University of Notre-Dame, K. GRZYWACZ-JONES, S. PADGETT, Dept. of Physics & Astronomy University of Tennessee, A.L. CARALEY, State University of New York at Oswego — Evaporation Residues (ER) from collisions of $^{134}$Sn, $^{134}$Sb and $^{134}$Te ions with a $^{64}$Ni target were measured at three beam energies (530, 500 and 480 MeV). The purpose of the experiment is to find out to what degree single-particle states near and below the Coulomb barrier is enhanced (or supressed) due to the presence of loosely bound valence neutrons in the collisions induced by the Sn and Sb isobars. The technique used to obtain cross sections for all three isobars and a comparison of ER yields in the three systems will be presented.

Oak Ridge National Laboratory is supported by the U.S. Dept, of Energy under contract No. DE-AC05-00OR22725 with UT-Battelle, LLC.

10:24AM CE.00008

Sub-barrier Fusion of radioactive $^{132}$Sn and $^{64}$Ni

J.F. LIANG, D. SHAPIRA, C.J. GROSS, R.L. VARNER, J.R. BEENE, P.E. MUELLER, D.W. STRACENER, Physics Division, Oak Ridge National Lab — Fusion induced by neutron-rich radioactive ion beams has received substantial experimental interest and theoretically in recent years. The fusion excitation function of radioactive $^{132}$Sn on $^{64}$Ni has been measured. The cross-sections were determined by measuring the percent transfer of neutrons and protons to be controlled separately. Comparisons of HIPSE coupled with the SMM, SIMON and Gemini de-excitation codes will be presented.

Oak Ridge National Laboratory is supported by the U.S. Department of Energy under contract No. DE-AC05-00OR22725 with UT-Battelle, LLC.

10:36AM CE.00009

Measurement of the $^{134}$Te(d,p)$^{135}$Te Reaction in Inverse Kinematics

STEVEN PAIN, Rutgers University, ORRUBA/RIBENS COLLABORATION — The development of high quality radioactive beams, such as those at the HIRIFB at ORNL, has made possible the performance of transfer reactions on unstable nuclei. Measurements of (d,p) reactions on n-rich fission fragments yield data on nuclear structure away from stability, and are of astrophysical interest due to the proximity to suggested r- process paths. The energies and spectroscopic information of single-particle states near to shell closures are of particular importance, since they provide both an important constraint on nuclear structure models and are directly relevant to direct neutron-capture cross sections. The single-neutron states in $^{135}$Te, one neutron beyond the N=82 shell closure, are of particular interest, both for r-process nucleosynthesis and its relevance to an isotopic anomaly of Xe found in pre-solar meteoritic grains. The $^{134}$Te(d,p)$^{135}$Te reaction has been measured in inverse kinematics at the HIRIFB utilizing a beam of $^{134}$Te at 643 MeV and a deuterated plastic target. Proton ejectiles were detected forward and backward of $\theta_{lab} = 10^{°}$ using an early implementation of the Oak Ridge Rutgers University Barrel Array (ORRUBA) in conjunction with SIDAR. Details of the experiment and the current stage of the data analysis will be presented.

10:48AM CE.00010

Nucleon Transfer Calculations Using the HIPSE Model

Z. KOHLEY, Texas A & M University, D. LACROIX, LPC CAEN, G.A. SOULIOTIS, Texas A & M University, A.L. KEKSIS, Los Alamos National Lab, B. STEIN, D.V. SHETTY, S. SOISSON, S.J. YENNELLO, Texas A & M University — The HIPSE (Heavy-Ion Phase-Space Exploration) model has been used to examine nucleon transfer during the interaction of the projectile and target. The results of the HIPSE model were compared to experimental data obtained on the FAUST array for $^{208}$F + $^{108}$Ag, $^{208}$F + $^{197}$Au, $^{208}$F + $^{197}$Au, and $^{208}$Ne + $^{197}$Au at 32 MeV/u. The apparent mass change of the projectile was calculated for fully reconstructed events, in which the total detected charge was equal to the charge of the beam. The experimental results had shown that both the mean values and the distribution widths of the mass transfer plots varied with the N/Z of the compound system. The HIPSE results were in good agreement with the experimental data for the more neutron-rich systems. For the less neutron-rich systems, the HIPSE model overestimated the loss of neutrons from the projectile. The difference between the theoretical and experimental data may be due to the fact that the HIPSE model does not treat the transfer of neutrons and protons differently. The HIPSE code was modified to allow for the percent transfer of neutrons and protons to be controlled separately. Comparisons of HIPSE coupled with the SMM, SIMON and Gemini de-excitation codes will be presented.
11:00AM CE.00011 Microscopic calculations of heavy-residue formation in quasielastic and deep-inelastic collisions below the Fermi energy. G.A. SOULIOTIS, D.V. SHETTY, S. GALANOPoulos, S.J. YENELLO, Cyclotron Institute, Texas A&M University — During the last several years we have undertaken a systematic study of heavy residues formed in quasi-elastic and deep-inelastic collisions near and below the Fermi energy [1,2]. Presently, we are exploring the possibility of extracting information on the dynamics by comparing our heavy residue data to calculations using microscopic models based on the quantum molecular dynamics approach (QMD). We have performed detailed calculations of QMD type using the recent version of the constrained molecular dynamics code CoMD of M. Papa [3]. CoMD is especially designed for reactions near the Fermi energy. It implements an effective interaction with a nuclear-matter compressibility of K=200 (soft EOS) with several forms of the density dependence of the nucleon-nucleon symmetry potential. CoMD imposes a constraint in the phase space occupation for each nucleon, thus restoring the Pauli principle at each time step of the collision. Results of the calculations and comparisons with our residue data will be presented and discussed in detail. [1] G.A. Soulisotis et al., Phys. Rev. Lett. 91, 022701 (2003); Nucl. Instrum. Methods B 204 166 (2003). [2] G.A. Soulisiotis et al., Phys. Lett. B 588, 35 (2004). [3] M. Papa et al., Phys. Rev. C 64, 024612 (2001).

11:12AM CE.00012 Observation of isomer production in abrassion fission of $^{238}$U on a $^{9}$Be Target . A.S. NETTLETON, A.M. AMTHOR, C.M. FOLDEN III, T.N. GINTER, M. HAUSMANN, D.J. MORRISSEY, M. PORTILLO, B.M. SHERRILL, O.B. TARASOV, NSCL, T. KUBO, T. NAKAO, H. TAKEDA, RIKEN, W.D. LOVELAND, Oregon State University, S.L. MANIKONDA, Argonne National Laboratory, G.A. SOULIOTIS, Texas A&M University — This talk will present the observation of gamma decay from isomeric states produced in abrassion fission of $^{238}$U on a $^{9}$Be target at 80 MeV/nucleon. This experiment was performed at the National Superconducting Cyclotron Laboratory at Michigan State University. The fission products were identified by A and Z, and with the gamma decay observed within a 20 microsecond window following implantation in a silicon telescope. This technique, for identification of breakup products is known as isomer tagging. Isomer tagging has become an important tool for in-flight fragment identification of fission and fragmentations products. Unfortunately an extensive database of isomers is unavailable for much of the neutron rich region populated by fission. Because of this, one of the goals of fission studies at the NSCL has been to measure the population of isomeric states. These results along with the possible identification of previously unknown isomeric states will be presented.

11:24AM CE.00013 Development of an Advanced Fission - Fusion - Evaporation Residue Detection System1, A.L. CARALEY, State University of New York at Oswego, D. SHAPIRA, J.F. LIANG, C.J. GROSS, R.L. VARNER, J.R. BEENE, Oak Ridge National Laboratory, E. CHAVEZ, INF and UNAM — A detector system, to measure fission fragments and evaporation residues resulting from collisions induced by rare neutron-rich nuclei, is being designed. The detector system is intended for use with radioactive ion beams and with low intensity stable beams (≤ 5x10^4 particles per second) and will require high efficiency. The primary detector will consist of an ionization chamber lined with double-sided silicon-strip detectors and will provide for tracking and particle identification capabilities over a wide angular range. Design and simulation of the detector system, using GEANT4, is ongoing. Complete tracking and response simulations for fragments and residues will be performed by incorporating statistical-model-code events (e.g. from GEMINI or PACER) into the calculations. Details of the detector design and simulations and results of fission fragment and evaporation residue efficiency calculations will be presented. The impact of the expected performance on planned radioactive beam experiments, including attempts to synthesize heavy elements, will be discussed as well.

1Dr. Caraley is supported in part by the Dr. Nuala McGann Drescher Leave Program and by the Joint Institute for Heavy Ion Research.

11:36AM CE.00014 Fission of $^{238}$U at 80 MeV/u and Search for New Neutron-Rich Isotopes . C.M. FOLDEN III, A.M. AMTHOR, T.N. GINTER, M. HAUSMANN, D.J. MORRISSEY, A.S. NETTLETON, M. PORTILLO, B.M. SHERRILL, O.B. TARASOV, Michigan State University, T. KUBO, T. NAKAO, H. TAKEDA, RIKEN, W.D. LOVELAND, Oregon State University, S.L. MANIKONDA, Argonne National Laboratory, G.A. SOULIOTIS, Texas A&M University — Calculations for existing and future radioactive beam facilities indicate that fission of $^{238}$U may provide the highest intensities for many secondary beams, although only limited data exist for uranium energies in the range 50-500 MeV/u. An experiment to measure the cross sections and momentum distributions of fragments produced via fission following abrassion of an 80-MeV/u $^{238}$U beam with Be targets has been conducted at the National Superconducting Cyclotron Laboratory at Michigan State University. Recoiling fragments were spatially separated from the primary beam and identified using the A1900 fragment separator with magnetic rigidity varied in steps from 2.5 to 3.9 T m. Standard particle identification techniques were augmented by observing the decay of fission and evaporation products from known microsecond isomers. Additionally, a search for new neutron-rich isotopes was conducted and preliminary analysis has shown the production of many events along the limit of presently known isotopes. The latest results on these experiments and comparisons with theoretical models will be presented.

11:48AM CE.00015 N/Z Equilibration in Deep Inelastic Collisions and the Fragmentation of the Resulting Quasiprojectiles. AUGUST KEKIS, MARTIN VESELSKY, GEORGE SOULIOTIS, DINESH SHETTY, MARIAN JANDEL, ELIZABETH BELL, ANANYA RUANGMA, EILEEN WINDSCHER, JOSH GAREY, SARA PARKETON, CASS RICHERS, SHERRY YENELLO, Los Alamos National Laboratory — When target and projectile nuclei have different N/Z, the quasiprojectiles formed in deep inelastic collisions should have a mean N/Z between that of the N/Z of the target and the N/Z of the projectile. This depends on the amount of N/Z equilibration that occurred. Six reaction systems with different N/Z between target and projectile were studied at Texas A&M University Cyclotron Institute. The fragments were measured with FAUST, the Forward Array Using Silicon Technology. Two techniques were used to determine the quasiprojectile N/Z, which were then compared to a fully N/Z equilibrated system to study the amount of N/Z equilibration. The fragmentation of the quasiprojectiles was studied using isotopic, isotopic, fractional and mean N/Z yield comparisons between systems. The results show that the neutron richness of the system affects the fragment yields, with the neutron-rich nuclides populated preferentially by the neutron-rich systems. The N/Z distribution of the fragment yields was also studied and an inhomogeneous N/Z distribution between the LCPS (Z<3) and IMF’s (Z>2) was observed. This research was funded in part by the Department of Energy through grant DE-FG03-93ER40773 and the Robert A. Welch Foundation through grant A-1266.

12:00PM CE.00016 Determining the Density Dependence of the Nuclear Symmetry Energy and Its Impacts in Astrophysics with Heavy-Ion Reactions . LIE-WEN CHEN, WEI-ZHUO JIANG, PLAMEN KRASTEVI, Texas A&M University-Commerce, ANDREW STEINER, Michigan State University, AARON WORLEY, Texas A&M University-Commerce, JUN XIU, Shanghai Jiao-Tung University, GAO-CHAN YONG, Texas A&M University-Commerce — The density dependence of the nuclear symmetry energy is important for both nuclear physics and astrophysics. Recent data on isospin transport in heavy-ion reactions have allowed us to constrain significantly the symmetry energy at sub-saturation densities. In this talk we discuss promising probes of the symmetry energy at super-normal densities using heavy-ion reactions induced by high energy radioactive beams. Astrophysical impacts of the constrained symmetry energy on cooling mechanisms and mass-radius correlations of neutron stars as well as the changing rate of the gravitational “constant G” will also be discussed.

Friday, October 12, 2007 9:00AM - 11:36AM —
Session CF Mini-Symposium on Baryon Resonances and Meson Production I Newport News Marriott at City Center Pearl Salon II
9:00 AM CF.00001 Nucleon resonance and electromagnetic meson production reaction. TORU SATO, Osaka University, EBAC@Jlab — Accurate determination of the $N^*$ parameters is a crucial step towards the understanding of hadron structure and reaction in terms of QCD in the non-perturbative region. Now precise and extensive data of photo and electroproduction of mesons are available from the intensive experimental efforts, which make it possible to extract accurate parameters of the excited baryons $N^*$. In the past years, the $N\Delta$ transition has been studied using various theoretical approaches. It is now recognized that the meson cloud effects play an important role in understanding transition form factors. Above the $\Delta(1232)$ resonance, the meson production reaction becomes highly inelastic. In order to extract $N^*$ parameters from the data it is challenging but necessary to establish an approach to take into account the coupled channel effects of the various meson production channels. In this talk I will briefly review theoretical approaches to analyze the meson production reactions beyond the delta region. In particular, the coupled channel model of EBAC and the resonance parameters in this approach will be discussed. Recent results on the $N^*$ parameters from the analysis of single pion production reaction will be shown. A plan to extend the present EBAC analysis by incorporating the data of inelastic reactions in collaboration with experimentalists will be discussed.

9:36 AM CF.00002 Dynamical coupled-channel approach to omega meson production with pions and photons. MARK PARIS, EBAC@Jefferson Lab, T.-S. HARRY LEE, Argonne National Lab, TORU SATO, Osaka University, EXCITED BARYON ANALYSIS CENTER COLLABORATION — A dynamical coupled-channel formalism is employed in the study of pion and photon induced omega meson production. We consider center-of-mass energies in the region from threshold to 2 GeV. Extensive optimization on parallel processors has been used to determine the parameters of the model hadronic Lagrangian. Non-resonant and resonance parameters are extracted from a least-squares global fit to the available observed differential cross section for $\pi N \rightarrow \omega N$ and $\gamma N \rightarrow \omega N$. The extracted strong and electromagnetic couplings are then used to calculate the electroproduction data. The importance of coupled-channel and off-shell effects is emphasized in comparisons to approximate $K$ matrix and other models.

1This work supported by the U.S. National Science Foundation.

9:48 AM CF.00003 Partial-wave analysis and spectroscopy. From pion-nucleon scattering to pion electroproduction up to $W = 2.5$ GeV. RICHARD ARNDT, BILL BRISCOE, IGOR STRAKOVSKY, RON WORKMAN, The George Washington University — We have analysed data on pN elastic scattering along with the single pion photo- and electroproduction channels. The main focus is a study of low-lying resonances. Fits to electromagnetic pion production have been used to extract multipoles as functions of Q2. Our results are compared to other recent determinations.

1Supported in part by the US Department of Energy.

10:00 AM CF.00004 $\pi^0$ electroproduction in the resonance region. NIKOLAY MARKOV, MAURIZIO UNGARO, University Of Connecticut, COLE SMITH, University of Virginia, KYUNGSEON JOO, University Of Connecticut. CLAS COLLABORATION — We report the analysis of single $\pi^0$ electroproduction in the resonance region to study the electromagnetic excitation of nucleon resonances. The study is aimed at understanding of the internal structure and dynamics of the nucleon. The experiment was performed using an unpolarized cryogenic hydrogen target and 2.0 GeV polarized electron beam during the e1F run period with CLAS at Jefferson Lab. The new measurements will produce a data base with high statistics and large kinematic coverage for the hadronic invariant mass $W$ up to 1.9 GeV in the momentum transfer $Q^2$ range of 0.3 - 1.0 GeV$^2$. Preliminary partial wave analysis results will be presented and compared with the various model calculations.

1Supported by DOE, Office of Nuclear Physics, No.DE-AC02-06CH11357, DE-AC02-06R23177, DE-FG02-96ER40950, European HPP RI3-CT-2004-500078, a Grant-in-Aid for MEXT of Japan No. 18042003.

10:12 AM CF.00005 Dynamical Coupled-channel analysis of pion electroproduction data in the $W < 2$ GeV resonance region. L.C. SMITH, EBAC@Jlab, University of Virginia, B. JULIA-DIAZ, EBAC@Jlab, University of Barcelona, T.-S. H. LEE, EBAC@Jlab, Argonne National Lab, A. MATSUYAMA, EBAC@Jlab, Shizuoka University, T. SATO, EBAC@Jlab, Osaka University — Within a dynamical coupled-channel model developed recently at EBAC, we have analyzed single pion electroproduction data from CLAS. The channels included are $\gamma N$, $\pi N$, $\eta N$ and $\pi\pi N$ which has $\pi\Delta$, $\rho N$, and $\sigma N$ resonant components. The hadronic parameters of the model have been determined from fitting the $\pi N$ scattering data up to $W = 2$ GeV. The determined $\gamma^* N \rightarrow N^*$ form factors for all low-lying $N^*$ states will be presented. The relations with the analysis based on the unitary isobar models will be discussed.

1Supported by DOE, Office of Nuclear Physics, No.DE-AC02-06CH11357, DE-AC02-06R23177, DE-FG02-96ER40950, European HPP RI3-CT-2004-500078, a Grant-in-Aid for MEXT of Japan No. 18042003.

10:24 AM CF.00006 Extractions of Resonance Parameters with Speed-Plot and Time-Delayed methods. NOBUHIKO SUZUKI, TORU SATO, Osaka University, TSUNG-SHUNG LEE, Argonne National Laboratory — Within several exactly solvable multi-channel multi-resonance models, the conditions under which the Speed-Plot and Time-Delayed Methods are valid in extracting resonances from the scattering amplitudes are studied. We then apply the methods to extract the nucleon resonances from the $\pi N$ amplitudes generated from a recently constructed dynamical coupled-channel model of $\pi N$ scattering up to $W = 2$ GeV. The results comparing our findings and the values of Particle Data Group will be presented and discussed.

1 This work is supported by a Grant-in-Aid for Scientific Research on Priority Areas(MEXT), Japan with No. 18042003, the US Department of Energy, Office of Nuclear Physics Division No.DE-AC02-06CH11357 and No. DE-AC06-06R23177.

10:36 AM CF.00007 Photon beam asymmetry for $\pi^0$ and $\pi^+$ 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 from CLAS on photon beam asymmetry for both the $\pi^0$ and $\pi^+$ 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.

1This work is supported by the U.S. National Science Foundation.
10:48AM CF.00008 Electroexcitation of the Roper Resonance at $Q^2 < 4.2 GeV^2$. INNA AZNAURYAN, Yerevan Physics Institute and Jefferson Lab, VOLKER BURKERT, VICTOR MOKEEV, Jefferson Lab — The helicity amplitudes of the electroexcitation of the Roper resonance on proton are extracted at $1.7 < Q^2 < 4.2 GeV^2$ from recent high precision CLAS data on the cross sections and longitudinally polarized beam asymmetry for $\pi^+ \rightarrow \mu e \nu$ electroproduction on protons. The phenomenological analysis of the data was made using two approaches: dispersion relations and unitary isobar model. It is found that the transverse helicity amplitude for the $\gamma p \rightarrow P_{11}^c(1440)$ transition, which is large and negative at $Q^2 = 0$, becomes large and positive at $Q^2 \approx 2 GeV^2$, and then decreases smoothly. Longitudinal helicity amplitude, which previously was found from CLAS data as large and positive at $Q^2 = 0.4$, 0.65 GeV$^2$, with increasing $Q^2$ drops rapidly. These results definitely rule out interpretation of the $P_{11}(1440)$ as a $q^3 G$ hybrid state, and provide strong evidence in favour of the interpretation of this state as a radial excitation of the nucleon.

11:00AM CF.00009 The Double Spin Asymmetry for Exclusive $\pi^+$ Production With CLAS. JOSHUA PIERCE, University of Virginia, CLAS COLLABORATION — The eg1b run was conducted using CLAS at Jefferson Lab using a 1.6 GeV - 5.6 GeV longitudinally polarized electron beam and polarized nuclear targets (composed of NH$_3$ and ND$_3$). This analysis is of the double spin asymmetry $A_{\lambda\mu}$ in the exclusive production of positive pions from a polarized proton ($e p \rightarrow e^+ \pi^+ n$). The double spin asymmetry was measured as a function of the four kinematic variables $W$, $Q^2$, $\cos \theta^*$ (the angle between the direction of the virtual photon and the produced pion), and $\phi$ (the angle between the lepton interaction plane and the hadron interaction plane). The value of this asymmetry can be used to determine the spin structure of the resonances. A brief description of the experimental setup will be given, and preliminary results will be shown.

11:12AM CF.00010 Exclusive $\pi^-$ Production from Deuterium. JIXIE ZHANG, Old Dominion University, CLAS COLLABORATION — As part of a complete study of baryon resonances, data on the $n \rightarrow p \pi^- \gamma$ channel is clearly important. However, there are very few data available for this channel because of the difficulty inherent in obtaining a neutron target. To overcome this limitation, the CLAS collaboration at Jefferson Lab has constructed a low momentum recoil detector (BoNuS) based on GEMs for use with a deuteron target. By tagging the spectator proton ($p_1$), one can isolate events in which the electron scatters from the neutron. In 2005 electron scattering data were taken with beam energies of 2.1, 4.2 and 5.3 GeV using a 7 atm deuterium target in conjunction with the BoNuS and CLAS detectors. We will present preliminary results for events in which at least two of the three final state hadrons in the ed $\rightarrow e^p\pi^-$ channel are detected.

11:24AM CF.00011 Phenomenological studies of CLAS data on double charge pion electroproduction1, VICTOR MOKEEV, VOLKER BURKERT, Jefferson Lab, CLAS COLLABORATION — Comprehensive studies of unpolarized $\pi^-\pi^+$ electroproduction cross-sections, for the first time available from CLAS [1,2], were carried out within the framework of phenomenological approach [3]. Analysis of these data allowed us to establish all important mechanisms, contributing to this exclusive channel in $N^*$ excitation region at photon virtualities from 0.2 to 1.5 GeV$^2$. Electrocouplings for $P_{11}(1440)$, $D_{13}(1520)$ states at $Q^2 < 0.6 GeV^2$ were obtained from the analysis of CLAS data [1]. The contributions from various mechanisms in terms of both amplitudes and single differential cross-sections were determined from the data fit. This information is of particular interest for $N^*$ studies in coupled channel approaches under development at EBAC [4].

1Friday, October 12, 2007 9:00AM - 11:48AM — Session CG Nuclear Structure II — Newport News Marriott at City Center Pearl Salon III

9:00AM CG.00001 Yrast structures of neutron-rich $^{51}$Ca and $^{52}$Sc1, S. ZHU, R.V.F. JANSSSENS, M.P. CARPENTER, T. LAURITSEN, D. SEWERRYNAK, Argonne National Laboratory, B. FORNAL, R. BRODA, W. KROLAS, T. PAWLAT, J. WRZESINSKI, Institute of Nuclear Physics, PAN, Poland, N. MARGINEAN, L. CORRADI, G.DE ANGELES, INFN, Laboratori Nazionali di Legnaro, Italy, M. HOMMA, University of Aizu, Japan, P.F. MANTICA, Michigan State University, P. MASON, INFN, Sezione di Padova and Università di Padova, Italy, T. OTSUKA, University of Tokyo, Japan — An N=32 subshell closure in neutron-rich nuclei around doubly-magic $^{48}$Ca occurs due to the weakness of the strong $\pi f_{7/2} - \nu f_{5/2}$ monopole interaction as protons are removed from the $f_{7/2}$ shell. With more proton removed, the splitting between the $\nu p_{1/2}$ and $\nu f_{5/2}$ states may be sufficient to produce a subshell closure at $N=34$. $\gamma$ coincidence events, from species produced in deep-inelastic collisions of a $^{16}$O beam on a thick $^{238}$U target, were collected with the Gammashere array at Argonne. The same system was investigated by employing the PRISMA spectrometer coupled with the CLARA $\gamma$-ray multi-detector array at the INFN, LNL Legnaro. Analysis of the combined data sets allowed us to identify the $\gamma$ transitions in $^{50}$Ca and $^{52}$Sc, and to construct extended level schemes. The energy of these states will be compared with the results of shell model calculations.

2This work was supported by the U.S. Department of Energy, Office of Nuclear Physics, under contract No. DE-AC02-06CH11357

9:12AM CG.00002 Precision Branching Ratio Measurement for the Superallowed $\beta^+$ Emitter $^{62}$Ga. PAUL FINLAY, C.E. SVENSSON, R.A.E. AUSTIN, G.C. BALL, D. BANDYOPADHYAY, A. CHAFFEY, R.S. CHAKRAWARTHY, P.E. GARRETT, G.P. GRINYER, G. HACKMAN, B. HYLAND, R. KANUNGO, J.R. LESLIE, C. MATTOON, A.C. MORTON, C.J. PEARSON, J.J. RESSLER, F. SARAZIN, H. SAVAJOLS — A high-precision branching ratio measurement for the superallowed $\beta^+$ emitter $^{62}$Ga has been made using the 8t $\gamma$-ray spectrometer in conjunction with the Scintillating Electron-Positron Tagging AARay (SCEPTAR) 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 high-purity beam of $\sim 10^{14}$ $^{62}$Ga/s in December 2005. The present work represents the highest statistics measurement of the $^{62}$Ga superallowed branching ratio to date. 25 $\gamma$ rays emitted following non-superallowed decay branches of $^{62}$Ga have been identified and their intensities determined. These data yield a superallowed branching ratio with $10^{-4}$ precision, and our observed branch to the first nonanalogue $0^+$ state sets a new upper limit on the isospin-mixing correction $\delta(C)$. By comparing our $\delta(C)$ value with the world average $\tilde{\delta}(C)$, we make stringent tests of the different calculations for the isospin-symmetry-breaking correction $\delta(C)$, which is predicted to be large for $^{62}$Ga.
9:24AM CG.00003 Enhanced lifetime measurement of low-lying states in 66Ge and 68Ge\textsuperscript{1}.

ROBERT LUETTKUE, Yale University / TU Darmstadt, ELIZABETH RICARD-MCCUTCJHAN, VOLKER WERNER, HO-CHIANG AI, ROBERT CASPERSON, RICHARD CASTEN, ANDREAS HEINZ, JING QIAN, Yale University, BABAK SHORAKA, Yale University / University of Surrey, RUSS TERRY, ELIZABETH WILLIAMS, RYAN WINKLER, Yale University — Lifetimes of the Z=N+2 nucleus 66Ge and its neighbor 68Ge have been measured after a fusion evaporation reaction at the Wright Nuclear Structure Laboratory at Yale University, using the New Yale Plunger Device in the SPEEDY array. 66Ge was produced through the reaction 78Ni(13B,2n)66Ge at E\textsubscript{13B}=28 MeV, and 68Ge through 58Ni(12C,2p)68Ge at E\textsubscript{12C}=38 MeV. Techniques used include gamma-gamma-coincidences and the recoil distance method. By comparing both nuclei, the evolution along the neutron-axis away from N=Z will be discussed.

\textsuperscript{1}This work was supported by US DOE grant no. DE-FG02-91ER-40609.

9:36AM CG.00004 A g-factor measurement of the 4\textsuperscript{+} state in 76Ge, G. GÜRDAL, N. BENČER-KOLLER, G. KUMBARTZKI, Rutgers University, H. AI, R. CASPERSON, R.F. CASTEN, A. HEINZ, E.A. MCCUTCJHAN, J. QIAN, V. WERNER, E. WILLIAMS, R. WINKLER, WNSL, Yale University — The 70–76Ge isotopes are transitional nuclei with $E2^+/E2^-$ ratios varying from 2.07 to 2.51. The systematic studies of g factors of 2\textsuperscript{+} and 4\textsuperscript{+} excited states provide an understanding of the microscopic structure of these nuclei since the g factors are very sensitive to the proton and neutron contributions to the wave functions. The measured results can be compared to the predictions of either shell model calculations or collective vibrational excitations. The measured g factors of 2\textsuperscript{+} in Ge nuclei, as well as in neighboring Zr and Se nuclei show reasonable agreement with Z/A, a signature of collective behavior. However, in this region the g factors of the 4\textsuperscript{+} states are somewhat larger than Z/A, albeit with large error bars. In this work, the first measurement of the g factor of the excited 4\textsuperscript{+} state of 76Ge using the Transient Field (TF) technique will be presented. The 4\textsuperscript{+} state of 76Ge was populated by Coulomb excitation on a C target of a beam of Ge (190–230 MeV) in inverse kinematics. Work supported by the U.S. National Science Foundation and U.S.D.O.E under grant DE-FG02-91ER-40609.

9:48AM CG.00005 Low-energy Coulomb excitation of radioactive 70Se\textsuperscript{1}, AARON HURST, Lawrence Livermore National Laboratory, REX-ISOLDE COLLABORATION, MINIBALL COLLABORATION — An isobarically pure beam of 70Se ions was post accelerated to an energy of 206 MeV using REX-ISOLDE. Coulomb-excitation yields for states in the beam and target nuclei were deduced by recording de-excitation \gamma rays in the highly segmented MINIBALL \gamma-ray spectrometer in coincidence with scattered particles in a silicon detector. At these energies, the Coulomb-excitation yield for the 2\textsuperscript{+} state of 70Se is expected to be strongly sensitive to the sign of the spectroscopic quadrupole moment through the nuclear reorientation effect. Experimental evidence is presented here for a prolate shape for this state, using an earlier published lifetime measurement, reopening the question over whether there are deformed oblate shapes close to the ground state in the neutron-deficient selenium isotopes.

\textsuperscript{1}This work was supported by the U.K. EPSRC, the ISOLDE Collaboration, the German BMBF, the EU VIth framework EURONS initiative, and the U.S. DOE by UC-LLNL under contract No. W-7405-Eng-48.

10:00AM CG.00006 Decay spectroscopy of 76–78Cu and 83,84Ga\textsuperscript{1}, C.J. GROSS, K.P. RYKACZEWSKI, D. SHAPIRA, ORNL, J.A. WINGER, S.V. ILYUSHKIN, Miss. St. U., R.K. GRZYWACZ, J.C. BINGHAM, S.N. LIDDICK, C. MAZZOCCHI, S. PADGETT, M.M. RAJABALI, U. Tennesse, E.F. ZGANJAR, A. PIECHACZEK, LSU, J.C. BATCHELDER, ORAU, J.H. HAMILTON, C. GOODIN, Vanderbilt, A. KORGUL, Warsaw, W. KROLAS, Krakow — We have developed a technique to enhance beta decay studies of neutron-rich fission products by ranging-out high Z isobars or tagging all decays and the NSCL Segmented Germanium Array (SeGA) to monitor the emitted gamma rays. All detectors were read out with a new digital data acquisition system based on the Pixie16 boards produced by XIA and further developed at the University of Tennessee and Oak Ridge National Laboratory. Preliminary results of the experiment and the performance of the digital acquisition will be presented. This work was supported in part by the NSF Grant PHY-06-06007 and by the DOE Grants DE-FG02-96ER40983, DE-AC05-00OR22725, DE-FG02-96ER401006 and in part by the NNSA through DOE Cooperative Agreement DEFC03-03NA00143.

1Supported by U.S. Dept. of Energy.

10:12AM CG.00007 Beta decay studies of neutron-rich nuclei near 78Ni. S.N. LIDDICK, M. RAJABALI, R. GRZYWACZ, C.R. BINGHAM, I.G. DARBY, U. Tennesse, T. GINTER, P. MANTICA, MSU/NSCL, K.P. RYKACZEWSKI, ORNL, C. MAZZOCCHI, U Milan/INFN, J.C. BATCHELDER, UNIRC/ORAU, S.V. ILYUSHKIN, J.A. WINGER, Miss St U, M. KARNY, K. MIERNIK, M. PFUTZNER, IEP District University, R. CASPERSON, W. KROLAS, J. C. BINGHAM, S. N. LIDDICK, M. RAJABALI, C. MAZZOCCHI, ORNL, J. A. WINGER, S. V. ILYUSHKIN, Miss. St. U., R. K. GRZYWACZ, J. C. BINGHAM, S. N. LIDDICK, M. RAJABALI, C. MAZZOCCHI, U. Tennesse, E. F. ZGANJAR, A. PIECHACZEK, LSU, J. C. BATCHELDER, ORAU, J. H. HAMILTON, C. GOODIN, Vanderbilt, A. KORGUL, Warsaw, W. KROLAS, Krakow — We have developed a technique to enhance beta decay studies of neutron-rich fission products by ranging-out high Z isobars or tagging all decays and the NSCL Segmented Germanium Array (SeGA) to monitor the emitted gamma rays. All detectors were read out with a new digital data acquisition system based on the Pixie16 boards produced by XIA and further developed at the University of Tennessee and Oak Ridge National Laboratory. Preliminary results of the experiment and the performance of the digital acquisition will be presented. This work was supported in part by the NSF Grant PHY-06-06007 and by the DOE Grants DE-FG02-96ER40983, DE-AC05-00OR2275, DE-FG02-96ER401006 and in part by the NNSA through DOE Cooperative Agreement DEFC03-03NA00143.

1Supported by U.S. Dept. of Energy.

10:24AM CG.00008 Structure of Fe isotopes at the limits of the pf-shell\textsuperscript{1}, NATHAN HOTELING, W.B. WALTERS, Department of Chemistry, University of Maryland, College Park, MD 20742, R.V.F. JANSSENS, Department of Physics, Argonne National Laboratory, Argonne, IL 60439 — In this paper, new data from the deep-inelastic reaction of 64Ni and 238U will be discussed with respect to new levels identified in the Fe isotopes near N=40. Results will be discussed within the framework of the shell model “beyond the pf-shell”, and implications to the structural trends in this region will be assessed. Particular emphasis will be directed toward new level schemes that have been deduced for 61Fe and 62Fe, and new low-spin structure identified from beta-decay of 63Mn in “delayed” spectra.

\textsuperscript{1}This work is supported by the U.S. Department of Energy and the National Science Foundation.
10:36AM CG.00009 Investigation of the Spin cut-off Parameter of nuclear Level Density1, AZIZ N. BEHKAMI, Farsi Science and Research Institute, Azad University, Iran — The spin cut-off parameter has been investigated within the microscopic approach based on the BCS Hamiltonian. This parameter has been determined for a long range of even-even, odd-A and odd-odd, light, medium weight as well as heavy and spherical and deformed nuclei. The spin cut-off parameter $\sigma^2(E)$ has also be determined using the macroscopic methods and the results are compared with their corresponding microscopic values. It is found that the values of $\sigma^2$ at neutron binding energy $B_n$, show structure reflecting the shell model orbitals near the Fermi energy. The huge difference between $\sigma^2(B_n)$ deduced from the model calculations for nuclei near major shells indicates that the large angular momentum are responsible for their differences. In particular, the $l_{f/2}$, $l_{p/2}$ and $l_{11/2}$ proton orbitals and the $l_{9/2}$, $l_{11/2}$ and $l_{13/2}$ neutron orbitals play an important role in the $\sigma^2(B_n)$ values.

1Work was supported by research council of Farsi Science and Research Institute, Azad University.

10:48AM CG.00010 Parity measurements in $^{80}$Sr1, R.A. KAYE, C.S. MYERS, Ohio Wesleyan University, J. DÖRING, GSI, S.L. TABOR, T.D. BALDWIN, D.B. CAMPBELL, C. CHANDLER, M.W. COOPER, C.R. HOFFMAN, J. PAVAN, M. WIEDEKING, Florida State University, S.M. GEBRICK, Purdue University Calumet, L.A. RILEY, Ursinus College, M.A. HALLSTROM, Case Western Reserve University — High-spin states in $^{80}$Sr were studied using the $^{54}$Fe($^{28}$Si,2$p$) reaction at 90 MeV and the $^{58}$Ni($^{28}$Si,2$p$) reaction at 110 MeV using the Tandem-Superconducting LINAC accelerator at Florida State University (FSU). Prompt $\gamma-\gamma$ coincidences were measured in the first reaction using the FSU array of ten Compton-suppressed Ge detectors. $\gamma$-ray linear polarizations were measured in both reactions using three Clover detectors as Compton polarimeters. As a result of these measurements, the parities of three non-yrast band structures have been determined, confirming the interpretations of the most recent in-beam and $\beta$-decay studies. In particular, the most strongly populated non-yrast band has been assigned negative parity, in agreement with most other neighboring even-even nuclei. Another high-spin sequence, with a parity assignment left open by the most recent in-beam study, has been tentatively assigned negative parity.

1Supported in part by the National Science Foundation and the OUW Summer Science Research Program.

11:00AM CG.00011 High-spin states in $^{88}$Kr1, N. FOTIADES, LANL, A.F. LISETSKIY, Arizona Univ., J.A. CIZEWSKI, Rutgers Univ., R. KRÜCKEN, T.U.München, R.M. CLARK, P. FALLON, I.Y. LEE, A.O. MACCHIAVELLI, LBNL, J.A. BECKER, W. YOUNES, LLNL — High-spin states in $^{88}$Kr have been studied following the fission of the $^{226}$Th compound nucleus formed in a fusion-evaporation reaction ($^{190}$O at 91 MeV on $^{216}$Pb). The Gammasphere array was used to detect $\gamma-\gamma$ coincidences. High-spin states up to spin (16+)$^-$ and ~8 MeV excitation energy have been established. The level scheme reported for $^{88}$Kr in the spontaneous fission of $^{248}$Cm [1] has been enriched and extended to higher spin and excitation energies. Differences between the level scheme reported in [1] and that obtained in the present work will be discussed. The observed experimental states are also compared with theoretical shell-model and interacting-boson-model-2 calculations. This work has been supported by the U.S. Department of Energy under Contracts No. DE-AC52-06NA25396 (LANL), W-7405-ENG-48 (LBNL) and AC03-76SF00098 (LBNL) and by the National Science Foundation (Rutgers).


11:12AM CG.00012 Microscopic formation of mixed-symmetry states1, V. WERNER, WNSL, Yale University, N. BENČZER-KOLLER, P. BOUTACHKOV, G. KUMBARTZKI, E. STEFANOVA, Rutgers Univ., R. KÖRKEN, T.U.München, R.M. CLARK, P. FALLON, I.Y. LEE, A.O. MACCHIAVELLI, LBNL, J.A. BECKER, W. YOUNES, LLNL — The spin cut-off parameter has been investigated within the microscopic approach using the $\nu_{1/2}$ proton orbitals and the $\nu_{9/2}$ neutron orbitals. High-spin states up to spin (16+)$^-$ in $^{82}$Kr have been found to have pure F-spin near the N=50 shell closure. In Zr isotopes the proton and neutron contributions forming FS and MS states are isopolarized. A comparison of the calculated mixed-symmetry states in $^{82}$Zr with corresponding low-spin (n,n’$\gamma$) reaction and (n,$\gamma$) reaction results is made.

1Supported by USDOE grant nos. DE-FG02-91ER40609 and DE-FG52-06NA26206, and by NSF.

11:24AM CG.00013 Study of mixed-symmetry states in $^{94}$Zr with (n,n’$\gamma$) reaction1, ESMAT ELHAMDI, University of Kentucky, S.N. CHOUDRY, B. CRIDER, S. MUKHOPADHYAY, J.N. ORCE, M. SCHÖCK, M.T. MCCULLSTRE, S.W. YATES, University of Kentucky, A.P. TONCHEV GROUP, TUNL/Duke University, D. WEISSHAAR, NSCL — The low-spin structure of $^{94}$Zr has been studied with the $(n,n'\gamma)$ reaction at the University of Kentucky 7 MV Van de Graaff accelerator facility and at TUNL at Duke University. Branching ratios, lifetimes, multipolarities and spin assignments have been determined. The $2^+_1$ state at 1671.4 keV has been identified as the lowest mixed-symmetry state in $^{94}$Zr. $B(M1; 2^+_1 \rightarrow 0^+)$ = 0.335(5) $\mu_N^2$. This state has an anomalous decay behavior, i.e., $B(E2; 2^+_1 \rightarrow 0^+_1) = 8(1)$ W.u. is unusually larger compared to the $B(E2; 2^+_1 \rightarrow 0^+_1) = 4.9(11)$ W.u. The analysis of angular distribution data reveals even more anomalies in the states above the mixed-symmetry, $2^+_1\rightarrow2^+_1$, state. For example, the $2^+_1$ state, at 2330 keV decays strongly to the $2^+_1$ state, $B(E2; 2^+_1 \rightarrow 2^+_1) = 19(2)$ W.u. compared to the $4^+_1$ state at 1470 keV, $B(E2; 4^+_1 \rightarrow 2^+_1) = 0.88(2)$ W.u. Some results from the angular distributions data at $E_n=2.8$ and 3.5 MeV will be presented to address this issue.

1This material is based upon work supported by the U.S. National Science Foundation under Grant No. PHY-0546566.

11:36AM CG.00014 Low-lying States of $^{53}$Sc and $^{55}$Sc from Shell Model1, ERDAL DIKMEMEN, SUNDUZ KORKMAZ, Suleyman Demirel University, Department of Physics, Isparta 32260, Turkey, MICHEL VALLIERES, Department of Physics, Drexel University, Philadelphia, PA 19104 — We have carried out the shell model calculations for the odd-even $^{53}$Sc and $^{55}$Sc isotopes. We use three different two-body effective nucleon-nucleon (NN) interactions, KB3, FDP6, GXPF1, in the calculations. We obtain the low-lying energy spectra of $^{53}$Sc and $^{55}$Sc isotopes in the full pf-shell model space.

1Supported in part by The Scientific and Technological Council of Turkey, TUBITAK 105T092, and Suleyman Demirel University, SDBAP 1075-M-05.
9:00AM CH.00001 \( \pi N \) scattering in the \( \Delta(1232) \) region, BINGWEI LONG, UBIRAJARA VAN KOLCK, Department of Physics, University of Arizona — We develop a chiral effective field theory based on the rest-frame heavy-baryon formalism to describe \( \pi N \) scattering in the \( \Delta(1232) \) resonance region. The phase shift in the \( P_{33} \) elastic channel is calculated up to next-to-next-to-leading order. A comparison is made with phenomenological phase-shift analyses.

9:12AM CH.00002 Search for collective enhancement of the nuclear Schiff moment\(^1\), ALEXANDER VOLYA, Florida State University, NAFTALI AUEBACH, Tel Aviv University, VLADIMIR ZELEVINSKY, Michigan State University — The non-zero expectation value of the nuclear Schiff moment violates invariance under spatial inversion and time reversal and produces the electrostatic potential that induces the electric dipole moment (EDM) of the atom. The experimental discovery of the atomic EDM pursued by several experimental groups would mark a significant progress in understanding fundamental symmetries of nature: the best limits on P,T-violating forces come from the EDM measurements in Hg and Xe nuclei. Strong interactions in the nucleus influence the mixing of the value of the Schiff moment. The static octupole deformation was shown \(^1\) to produce large enhancement of the Schiff moment in deformed nuclei through the mixing of parity doublets. We study the idea \(^2\) of the possible enhancement in spherical nuclei with soft quadrupole and octupole collective modes. The existence of the effect was confirmed \(^3\) in the limit of very small collective frequencies in the framework of the RPA. We show the results of the exact diagonalization in the model with pairing and multipole-multipole forces that demonstrate the presence of the enhancement as a result of the mixing in the odd nucleus of states with the same angular momentum and opposite parity having large phonon components. \(^1\) V. Spevak, N. Auerbach and V.V. Flambaum, Phys. Rev. C 56 (1997) 1357. \(^2\) V.V. Flambaum and V.G. Zelevinsky, Phys. Rev. C 68 (2003) 035502. \(^3\) N. Auerbach, et.al., Phys. Rev. C 74 (2006) 025502.

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\(^1\) Supported by the grant from the Binational Science Foundation US-Israel and the NSF grant PHY-0555366.

9:24AM CH.00003 Poincaré Invariant Three-body Scattering, T. LIN, CH. ELSTER, Ohio Univ., W. POLYZOU, U. Iowa, W. GLOECKLE, Ruhr-Univ. Bochum — The Poincaré invariant Faddeev equation for three-body scattering is directly formulated in momentum space without employing a partial wave decomposition. The scattering amplitude is obtained as functions of vector momenta by solving the Faddeev equation in three dimensions through Padé iteration. Based on a Malfliet-Tjon type potential, differential cross sections for elastic and break-up scattering (inclusive and exclusive) are calculated at selected energies up to the GeV scale. The reaction mechanisms at higher energies associated with different kinematic configurations such as quasi-free (QFS) and final state interaction (FSI) are investigated and compared to the corresponding non-relativistic cross sections. Especially, multiple rescattering contributions beyond the leading order of the two-body \( t \) matrix are analyzed as function of energy and kinematic configuration.

9:36AM CH.00004 Decoupling via the Similarity Renormalization Group for Nucleon-Nucleon Forces\(^1\), E.D. JURGENSON, R.J. FURNSTAHL, Ohio State Univ., S.K. BOGNER, Michigan State Univ. — The Similarity Renormalization Group (SRG) provides a compelling new method for decoupling low-energy nuclear physics from high-energy details. While observables are unchanged by the SRG’s unitary transformations, the dependence of matrix elements on high-momentum contributions is modified by the running transformation. The SRG has the effect of partially diagonalizing the potential to a width of order the evolution parameter lambda. Because of this diagonalization, one expects a simple decoupling of the low-energy observables for these high-energy degrees of freedom. In a previous work\(^2\) evidence for decoupling in phase shifts and the deuteron was shown for the Argonne V18 potential. Here we extend the demonstration of decoupling to other NN potentials and up to \( A=6 \) nuclei to verify its universal nature and to show quantitatively that the residual coupling is perturbative above the energy corresponding to the SRG evolution parameter.

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\(^1\) Supported in part by the NSF under grants Nos. PHY-0354916 and PHY-0553312.


9:48AM CH.00005 Chiral NN potentials and renormalization\(^1\), RUPRECHT MACHLEIDT, University of Idaho, DAVID ENTEM, University of Salamanca — In recent years, quantitative nucleon-nucleon (NN) potentials based upon chiral perturbation theory (ChPT) have been developed. All these potentials apply what is known as “Weinberg power counting”. However, this renormalization scheme has been the subject of varying forms of criticism for more than a decade. Systematic investigations of the issue conducted to date have been restricted to only the leading order (LO) of ChPT. Since quantitative chiral NN potentials are constructed at next-to-next-to-next-to-leading (N3LO), it is necessary to investigate the power counting issue beyond LO, and ultimately at N3LO. We have launched such a program and will report the current status of our findings.

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\(^1\) Supported in part by NSF Grant No. PHY-0099444.

10:00AM CH.00006 Loop Corrections and Naturalness in a Chiral Effective Field Theory\(^1\), BRIAN SEROT, JEFF MCINTIRE, Indiana University — The loop expansion is applied to a chiral effective hadronic lagrangian; with the techniques of Infrared regularization, it is possible to separate out the short-range contributions and to write them as local products of fields that are already present in our lagrangian. (The appropriate field variables must be re-defined at each order in loops.) The corresponding parameters implicitly include short-range effects to all orders in the interaction, so these effects need not be calculated explicitly. The remaining (long-range) contributions that must be calculated are nonlocal and resemble those in conventional nuclear-structure calculations. Nonlinear isoscalar scalar (\( \sigma \)) and vector (\( \omega \)) meson interactions are included, which incorporate many-nucleon forces and nucleon substructure. Calculations are carried out at the two-loop level to illustrate these techniques at finite nuclear densities and to verify that the coupling parameters natural when fitted to the empirical properties of equilibrium nuclear matter. Contributions from the \( \omega N \) tensor coupling are also discussed.

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\(^1\) This work was supported by DOE Contract No. DE-FG02-87ER40365.

10:12AM CH.00007 Operator Evolution via the Similarity Renormalization Group\(^1\), E.R. ANDERSON, Ohio State Univ., S.K. BOGNER, Michigan State Univ., R.J. FURNSTAHL, R.J. PERRY, Ohio State Univ. — The Similarity Renormalization Group (SRG) uses unitary transformations to suppress off-diagonal matrix elements, forcing the Hamiltonian towards a band-diagonal form. An SRG transformation applied to nucleon-nucleon interactions leads to greatly improved convergence properties while preserving observables, and provides a method to consistently evolve many-body potentials and other operators\(^2\). Here the nature of operator evolution is explored, taking as an example the operator for the bare momentum \( k \). The equivalence of a direct evolution via SRG equations and a construction from evolved eigenstates is shown. The flow of the operator and its matrix elements in the deuteron is exhibited and analyzed on the basis of the SRG flow equations for the operator. Conjectures\(^3\) on the factorization of the unitary operator \( U(k,q) \) into \( K_\lambda(k)Q(q) \) for \( k << \lambda \) and \( q \gg \lambda \) are explored pictorially and analytically.

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\(^1\) Supported in part by the NSF under Grants Nos. PHY-0354916 and PHY-0553312.


S. Bayegan and H.W. Grießhammer: Phys. Lett. channel: the thermal cross section of $^n\text{d}$ and spin-combination considered. The typical strength of most 3-body forces turns out weaker than expected, demoting many to high orders. As application, dimensional analysis must be amended as the asymptotic solution to the leading-order problem depends for large off-shell momenta crucially on the partial wave only two-body forces and the renormalisation-group argument that low-energy observables must be insensitive to details of short-distance dynamics. Na"ıve For the “pion-less” Effective Field Theory at momenta below the pion-mass, I provide a recipe to systematically estimate the typical size of 3-body forces when theory and data disagree is untenable when predictions are required. This research was supported by the U.S. Department of Energy under grant number DE-AC52-06NA25396.

EDWIN NORBECK, University of Iowa — A N-S monopole pair should form an atom, an analog of positronium. Such atoms might be created by colliding Pb beams at the LHC for which the available energy is 1144 TeV. The difficulty in understanding such systems can be seen by using the textbook positronium formula and Dirac’s observation that the effective “charge” of a monopole (to use in Coulomb’s law) is $67.5\, n$ times the electron charge. Even with the integer $n = 1$, the energy radiated by a pair of poles as the atom cascades to the ground state is 147 times the rest energy of the pair, in violation of energy conservation. Relativistic corrections increase this value. Vacuum polarization effects give a large correction in the right direction, but the usual QED cannot be used because the magnetic fine structure constant is huge, 137/4. Even without detailed calculations it can be assumed that the mass of the atom is much smaller than the mass of two free poles. As a newly produced pair begins to separate, one could expect additional poles to be produced from the vacuum resulting in two atoms moving away from each other. These atoms would self annihilate resulting in back to back jets.

For the “pion-less” Effective Field Theory at momenta below the pion-mass, I provide a recipe to systematically estimate the typical size of 3-body forces when theory and data disagree is untenable when predictions are required. This research was supported by the U.S. Department of Energy under grant number DE-AC52-06NA25396.

Department of Physics, George Washington University — To add 3-body forces when theory and data disagree is untenable when predictions are required. For the “pion-less” Effective Field Theory at momenta below the pion-mass, I provide a recipe to systematically estimate the typical size of 3-body forces in all partial waves and orders, including external currents [1]. It is based on the superficial degree of divergence of the 3-body diagrams which contain only two-body forces and the renormalisation-group argument that low-energy observables must be insensitive to details of short-distance dynamics. Naïve dimensional analysis must be amended as the asymptotic solution to the leading-order problem depends for large off-shell momenta crucially on the partial wave and spin-combination considered. The typical strength of most 3-body forces turns out weaker than expected, denoting many to high orders. As application, the thermal cross section of $n\text{d} \to t\gamma$ bears no new 3-body force [2], besides those fixed by the triton binding energy and $n\text{d}$ scattering length in the triton channel: $0.485(LO) + 0.011(NLO) + 0.007(NNLO)\,\text{mb} = [0.503 \pm 0.003]\,\text{mb}$, converges and compares well with data, $[0.509 \pm 0.015]\,\text{mb}$. Potential models list $[0.49 \ldots 0.66]\,\text{mb}$, depending on the 2-nucleon potential and inclusion of the $\Delta(1232)$. [1] H.W. Grießhammer: Nucl. Phys. A760 (2005) 110 [2] H. Sadeghi, S. Bayegan and H.W. Grießhammer: Phys. Lett. B643 (2006), 263.

10:48AM CH.00010 Quantum bound state of three protons in high magnetic field, SH. M. TSIKLAE, University of Phoenix, Jersey City Campus, R. YA. KEZERASHVILI, Physics Department, New York City College of Technology, CUNY, L.L. MARGOLIN, Marymount Manhattan College, New York — This paper consider possibility that three proton may bind uniform magnetic field. The purpose of this article is to use of the hyperspherical function method for investigation confined three protons. It is apparent that one requires magnetic fields order $10^{12} T$ for the Coulomb repulsion to be modest enough to be treated as a correction. Such magnetic fields are believed to be found in nature – on the surface of magnetars. This novel class of quantum bound states is the focus of the present paper.

11:00AM CH.00011 A Cluster Model of $^6\text{He}$ and $^6\text{Li}$, JEREMY ARMSTRONG, NSCL and Department of Physics and Astronomy, Michigan State University. ALEXANDER SAKHARUK, Division of Ecological Studies, Florida Gulf Coast University, VLADIMIR ZELEVINSKY, NSCL and Department of Physics and Astronomy, Michigan State University — Small nuclei provide an ideal testing ground of few-body theories. $^6\text{He}$ is particularly interesting in that it shows an extended particle distribution similar to a halo nucleus, is loosely bound, and is a Borromean system. We apply the Brink Formalism in second quantization to study the structure of $^6\text{He}$. This formalism allows for the proper treatment of Fermi statistics and correct projection into eigenstates of angular momentum. The alpha plus dineutron configuration and “cigar” (neutron, alpha, neutron chain) configuration were studied to obtain binding energies, charge radii, matter radii, and $B(E2)$ for $^6\text{He}$. The same configurations were used to obtain the same observables for $^6\text{Li}$. We were then able to calculate the log ft value for the beta decay of $^6\text{He}$. We now examine the effects of different nucleon-nucleon interactions on our systems.

11:12AM CH.00012 Transition energy correlations in the three-body continuum of Borromean Halo Nuclei, BORIS DANILIN, Kurchatov Institute, Moscow, Russia, JAN VAAGEN, TORBJOERN ROGDE, University of Bergen, Norway, SERGEY ERSHOV, JINR, Dubna, Russia, IAN THOMPSON, Lawrence Livermore National Laboratory, MIKHAIL ZHUJKOV, Chalmers University of Technology, Sweden, RNBTF COLLABORATION — Energy correlations in transitions from the bound state to the three-body continuum of Borromean halo nuclei are considered. A core+n+n three-body cluster model which reproduces experimentally known properties of $^6\text{He}$ and $^{11}\text{Li}$ has been used to study low-lying resonances and soft modes. The analysis of the correlated responses in $^6\text{He}$ shows that in the case of the narrow three-body $2^+_1$ resonance the transition energy correlations are the same as in the intrinsic correlated structure in $3 \to 3$ scattering. They differ significantly for wide $2^+_1$, $1^+_1$ resonances, and also for the soft dipole and monopole modes, where, due to the transition operators, the intertwined of the ground state and the three-body continuum plays a significant role.

11:24AM CH.00013 How to Classify Three-Body Forces — and Why, HARALD W. GRIESSHAMMER, Department of Physics, George Washington University — To add 3-body forces when theory and data disagree is untenable when predictions are required. For the “pion-less” Effective Field Theory at momenta below the pion-mass, I provide a recipe to systematically estimate the typical size of 3-body forces in all partial waves and orders, including external currents [1]. It is based on the superficial degree of divergence of the 3-body diagrams which contain only two-body forces and the renormalisation-group argument that low-energy observables must be insensitive to details of short-distance dynamics. Naïve dimensional analysis must be amended as the asymptotic solution to the leading-order problem depends for large off-shell momenta crucially on the partial wave and spin-combination considered. The typical strength of most 3-body forces turns out weaker than expected, denoting many to high orders. As application, the thermal cross section of $n\text{d} \to t\gamma$ bears no new 3-body force [2], besides those fixed by the triton binding energy and $n\text{d}$ scattering length in the triton channel: $0.485(LO) + 0.011(NLO) + 0.007(NNLO)\,\text{mb} = [0.503 \pm 0.003]\,\text{mb}$, converges and compares well with data, $[0.509 \pm 0.015]\,\text{mb}$. Potential models list $[0.49 \ldots 0.66]\,\text{mb}$, depending on the 2-nucleon potential and inclusion of the $\Delta(1232)$. [1] H.W. Grießhammer: Nucl. Phys. A760 (2005) 110 [2] H. Sadeghi, S. Bayegan and H.W. Grießhammer: Phys. Lett. B643 (2006), 263.
DA.00001 Real Photon Physics at MAMI 1. AMAL AL KATRIB, WILLIAM BRISCOE, The George Washington University, MAINZ MICROTON A2 COLLABORATION — The scientific program at the Mainz Microtron (MAMI) is based on polarized electron and photon beams from the MAMI A-B-C accelerator complex with energies up to 1500 MeV. In order to deal with the energy increase, the photon tagger 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. The Crystal Ball detector is being used regularly together with an inner detector for tracking and a forward crystal calorimeter (TAPS) for $4\pi$ coverage. A new data acquisition system with high-rate performance is in operation. Experiments are currently running using a liquid hydrogen/deuterium target. A cryogenic polarized frozen-spin target to be used in the Crystal Ball is near completion and will soon be used to provide polarized protons and deuterons (for polarized neutron experiments). A polarized HeI target is also under development. In this poster, we will present the current status of the experimental equipment and the role of student involvement in the experimental real photon program at MAMI.


DA.00002 Neutron Energy Spectra for Deuteron Beams Incident on Thin Targets 1. JESSAMYN ALLEN, University of California, Berkeley, PEGGY MCMAHAN, LAWRENCE HEILBRONN, JOE CERNY, DARREN BLEUEL, Lawrence Berkeley National Laboratory, BRAD BARQUEST, CYBELE JEWETT, University of California, Berkeley, IAN THOMPSON, LARRY AHLE, Lawrence Livermore National Laboratory — Neutron energy spectra and cross-section data have been measured for deuteron breakup on thin targets using the 88-Inch Cyclotron at Lawrence Berkeley National Laboratory. Data was collected for tantalum and titanium targets at deuteron energies 20, 29, 35 and 38 MeV. Using a NE213 liquid-scintillation counter with neutron/gamma pulse shape discrimination, energy spectra were determined at zero degrees by measuring the time-of-flight relative to the cyclotron R.F. Additional data was collected at larger angles for deuteron energy of 20 MeV. The data collected tests the predictions of current breakup models, aiding in further development of the codes providing a better understanding of the competition between Coulombic and nuclear breakup. Breakup systems will be useful in exploiting deuteron breakup as a mechanism for fast neutron production for a variety of applications.

DA.00003 Digital Timing Algorithm for High Purity Germanium Detectors. KNOX ANDREW, University of Massachusetts Lowell, KRZYSZTOF STAROSTA, DAVID MILLER, CONSTANTIN VAMAN, PHILLIP VOSS, DIRK WEISSHAAR, Michigan State University/National Superconduction Cyclotron Laboratory — The next generation of $\gamma$-ray detector arrays will be composed of large volume high purity germanium (HPGe) detectors that are electronically segmented. These detectors will be able to track $\gamma$-rays as they Compton scatter within the crystal and between adjacent crystals, eliminating the need for Compton suppression detectors and improving angular resolution. The new arrays will have much higher sensitivity, but require a shift from analog signal processing (ASP) to digital signal processing (DSP). The scope of the current project is to test the resolution of digital timing algorithms, a critical component of any $\gamma$-$\gamma$ tracking system. A $\gamma$-$\gamma$ coincidence experiment was performed with a 60Co source and two small volume HPGe detectors using the Digital Data Acquisition System at the National Superconducting Cyclotron Laboratory. The resultant digitized waveforms were analyzed using multiple algorithms. These included digital models of ASP leading edge and constant fraction discriminators, and simple novel digital techniques.

DA.00004 Angular Correlations in $^{96}$Mo. S. ATWATER, K. ALEKSANDROVA, University of Richmond, V. WERNER, Wright Nuclear Structure Laboratory, Yale University, P. VON BRETANTO, A. FITZLER, C. FRANSEN, A. LINNEMANN, Institut fr Kernphysik, Universitt zu Kln, J-R. TERRY, Wright Nuclear Structure Laboratory, Yale University, M.S. FETEA, University of Richmond — Gamma-gamma coincidences from $^{96}$Mo were detected by the OSIRIS cube spectrometer at the University of Cologne’s FN Tandem Accelerator, to identify low-lying M1 transitions between 2+ states using angular correlations. Preliminary analysis of the low energy 2+ to 2+ cascades will be presented. This work was supported by NSF OSG55665, Jeffress Fund J-809, and USDOE DE-FG02-03NA0078.

DA.00005 The One-Neutron Knockout Reaction $^{9}$Be($^{41}$S,$^{43}$S)$^{X}$ 1. T.R. BAUGHER, K.E. HOSIER, L.A. RILEY, Ursinus College, P.D. COTTLE, K.W. KEMPER, Florida State University, P. ADRICH, D. BAZIN, J.M. COOK, C.A. DIGET, A. GADE, D.A. GARLAND, T. GLASMACHER, A. RATKIEWICZ, K.P. SIWEK, D. WEISSHARR, National Superconducting, Cyclotron Laboratory, Michigan State University — We studied the structure of the exotic isotope $^{43}$S produced in the one-neutron knockout reaction $^{9}$Be($^{41}$S,$^{43}$S)$^{X}$. The experiment was conducted at the National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University. We measured gamma-rays emitted by the excited $^{43}$S nuclei produced in the reaction using the Segmented Germanium Array (SegA). We extracted the knockout cross sections for the reaction and used a GEANT simulation of SegA to fit our measured gamma-ray spectrum. An expanded level scheme was proposed. We also analyzed the momentum distributions of the knockout products in order to determine the orbital angular momentum of the neutron removed during the reaction.

1This work was supported by the National Science Foundation under grant nos. PHY-0606007, PHY-0355129, and PHY-0653323.

DA.00006 A study of systematic uncertainties in the Daya Bay Neutrino Experiment. ERIC BLANSHAN, UCLA/University of Chicago — The Daya Bay Experiment is designed to set a precise upper limit for, if not pin-point, the value of the $\theta_{13}$ neutrino oscillation parameter. As shown in the parameterized PMNS matrix, accurate knowledge of $\theta_{13}$ will enable the study of CP violation in the lepton sector, in addition to supporting the theory of neutrino oscillation. This experiment seeks great precision by utilizing four detector sites; each site will house two Ga-laced liquid scintillator anti-neutrino detectors which first measure a prompt signal from the electron-positron annihilation following the inverse beta decay reaction $^{8}$B $\rightarrow$ $^{8}$Be + $e^{+}$ + $\nu_{e}$. Two- photon invariant mass spectra binned in incident photon energy and production angle are fitted to extract yields for $^{8}$Be and $\nu_{e}$ meson photoproduction. Monte Carlo simulations are also being performed to determine the acceptance of the CLAS detector for these reactions. The analysis will be described and the procedures used to extract the yields and determine the acceptance will be discussed.

DA.00007 Extraction of Yields for Neutral Meson Photoproduction from the Proton and $^{3}$He with the CLAS Detector at Jefferson Lab 1. RICHARD BONVENTRE, CHRISTIAN SHULTZ, MICHAEL VINEYARD, Union College, CLAS COLLABORATION — The photoproduction of $\pi^{0}$ and $\eta$ mesons from hydrogen and $^{3}$He targets over an incident photon energy range of 0.5 - 1.5 GeV is being studied using data from the CEBAF Large Acceptance Spectrometer (CLAS) at Jefferson Lab. This is part of a systematic study of meson photoproduction from the proton and light nuclei targets to investigate possible nuclear medium modifications of nucleon resonances and meson-nucleon interactions. The neutral mesons are reconstructed from their two-photon decay. Two- photon invariant mass spectra binned in incident photon energy and production angle are fitted to extract yields for $\pi^{0}$ and $\eta$ meson photoproduction. Monte Carlo simulations are also being performed to determine the acceptance of the CLAS detector for these reactions. The analysis will be described and the procedures used to extract the yields and determine the acceptance will be discussed.

1Supported by the U.S. Department of Energy under contract number DE-FG02-03ER41252.
DA.00008 Impact of Nuclear Physics Uncertainties on Big Bang Nucleosynthesis Constraints on the Baryonic Matter Density, B.D. BRUNER, R.L. KOZUB, TTU, M.S. SMITH, L.F. ROBERTS, ORNL, D. TYTLER, G.M. FULLER, UCSD, E.J. LINGERFELT, W.R. HIX, C.D. NESTEL, ORNL/UT-K. The total amount of baryonic (“normal”) matter in the Universe can be constrained by comparing the primordial abundances of $^4$He and $^7$Li inferred from observations to the abundances predicted by the standard Big Bang Nucleosynthesis (BBN) theory. The centroid of this constraint depends on the input thermonuclear reaction rates responsible for the light element production in the early Universe and on the abundance observations. The width of the constraint is determined from the uncertainties in the observations, and by uncertainties in abundance predictions as determined by Monte Carlo BBN calculations in which thermonuclear reaction rate uncertainties are used. We have performed BBN Monte Carlo simulations wherein the reaction rate uncertainties are systematically reduced, to determine the impact that future nuclear physics measurements could have on the baryonic matter density constraint. The calculations were performed with the new suite of codes available at bigbangonline.org. Results of the simulations and their implications for future nuclear physics measurements will be presented. This research is supported by the USDOE.

DA.00009 The Development of a Cosmic Ray Veto System, JOSEPH BUCHANAN-VEGA, Gambling State University, JESSICA DUNMORE, BRENT VANDEVEN, JOHN WILKERSO, University of Washington — There are many experiments dedicated to the investigation of neutrino characteristics, such as the Majorana neutrinoless double-beta decay measurement, the Karlsruhe Tritium Neutrino Experiment, KATRIN, and the SNO solar neutrino experiment. Although the various neutrino experiments differ, they all must limit background interference because of the small numbers of events and/or the intervals of energies to be detected. At the University of Washington’s Center for Experimental Nuclear Physics and Astrophysics (CENPA) an EG&G germanium detector and shield has been constructed to allow preliminary radioassay of materials to be used in neutrino experiments. The detector is enclosed in lead to shield from environmental low energy radiation, and includes a scintillator veto system to eliminate cosmic rays from data. This system also serves as a developmental opportunity for Majorana R&D allowing the characterization of the germanium detector digitization electronics and analysis software.

DA.00010 Unstable Quantum Systems Coupled Via Continuum and Super Radiance, JUAN BURGOS, VLADIMIR ZELEVINSKY. Exited states of a quantum system are unstable and decay into the continuum. The dynamics of a of a quantum signal through a two dimensional lattice with open decay channels coupled to the continuum is treated by means of this discretized effective non-hermitian Hamiltonian. The energies and widths are treated as real and imaginary parts of complex eigenvalues for the effective Hamiltonian. Coupling through the continuum reorganizes the dynamics of the system, as a result the energy widths of the intrinsic states are redistributed and very broad states are formed absorbing a significant part of all the summed energy widths. As a result these broad, super-radiant states become highly unstable, with short lifetimes, while the remaining states become trapped and long lived. This notion of super radiance was suggested by Dicke, over fifty years ago, for systems pertaining to coherent states in quantum optics, much later was it realized that the mechanism of super radiance arises in many other areas of physical phenomena in atomic, nuclear and particle physics. A sharp, sort of phase transition, between weak and strong coupling to the continuum is considered. The weak coupling limit corresponds to isolated sharp resonances, whereas strong coupling corresponds to the collectivization of widths and the formation of the short lived Dicke states.

DA.00011 Cosmic Test Stand Development for PHENIX Muon Trigger Upgrade, ALEX BURNAP. PHENIX COLLABORATION — 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. In proton-proton collisions a quark and anti-quark interaction can be signaled by the formation of a W-Boson. At PHENIX, W- Bosons are detected through the presence of a high transverse momentum muon. The current level 1 trigger for single muons makes only a minimum energy cut of about 2 GeV and this results in data rates that far exceed the bandwidth capabilities of the data acquisition system. To rectify this, an upgrade to the current muon trigger is underway that will trigger only on high transverse momentum muons using new resistive plate counters (RPC). Before these RPCs will be installed in the PHENIX spectrometer, their quality will be certified through the use of a cosmic muon test stand. This test stand will consist of a plane of hodoscopes on top and bottom as triggers with 10 RPCs in between. The efficiency and spatial resolution of these RPCs will be measured. This poster will illustrate this testing process.

DA.00012 Heavy Meson Dynamics in Ultra-Relativistic Heavy-Ion Collisions, ALEJANDRO ACERES, Duke University — Heavy-ion collisions measured at RHIC have produced a novel state of ultra-high temperature and density matter called the strongly interacting Quark-Gluon-Plasma (sQGP). One of the most anticipated new measurements at RHIC centers on hadrons containing heavy quarks (i.e. charm/bottom quarks). These quarks are produced in form of charm-anticharm and bottom-antibottom pairs in hard pQCD interactions early in the time-evolution of the collision. In the absence of a QGP they would hadronize to form charmonium or bottomon states(i.e. J/Psi). However, color screening in the QGP may lead to suppression of such states —one observes the formation of D and B meson. The knowledge of the reaction dynamics of J/Psi and D mesons in the late hadronic phase of a heavy-ion reaction is crucial for the understanding of properties of the QGP and properties of heavy-quarks propagating through. For our analysis we employ a hadronic transport model, UrQMD, into which we have incorporated heavy-meson rescattering cross sections. We present an analysis of D meson and J/Psi collision rates, spectra and yields in the framework of the model and discuss their implications for measurements at RHIC.

DA.00013 Testing Scintillator Efficiency for Use in RPC Test Stand for PHENIX at RHIC, AMANDA CARLING, Muhlenberg College, PHENIX COLLABORATION — The PHENIX experiment at RHIC is a large-scale detector for the study of polarized proton-proton collisions and heavy ion collisions. An upgrade to the muon trigger is being constructed. This upgrade is necessary for a detailed study of W-boson particles. It will selectively trigger on high transverse momentum muons only and not on the low transverse momentum muon background. By reconstructing W-boson particles, new insight into the spin structure of a proton will be gained. Resistive Plate Chambers (RPCs) will be used in the trigger upgrade. An “RPC factory” is being setup to build and test the RPCs in order to test the RPCs we will be using a cosmic ray test stand in which hodoscopes are used as triggers. The hodoscopes are being built and tested for efficiency this summer. The efficiency of the hodoscopes is essential to the testing of the RPCs. Testing the RPCs in the cosmic ray test stand will be a time consuming process and without efficient hodoscopes as triggers the testing time will be significantly lengthened. By implementing a data acquisition system for the testing and use of the hodoscopes we are able to easily calculate efficiencies of the scintillators used to construct the hodoscopes. The methods, setup, and results for scintillator efficiency will be presented.

DA.00014 Focal Plane Scanning Detector for Qweak, LAURA COBUS, University of Winnipeg, QWEAK COLLABORATION — The Qweak experiment at Thomas Jefferson National Accelerator Facility will precisely measure the weak charge of the proton through parity-violating electron-proton scattering. Large-area Čerenkov detectors will be operated in integrating mode to sense the scattered electrons. Tracking studies such as Q^2 determination and physics backgrounds will be performed at beam currents below 100nA, where tracking detectors are operable. However, the parity-violation experiment must be conducted at 180µA in order to achieve the statistical goal of the experiment. We are constructing a scanning detector with small fiducial area to facilitate the extrapolation from low to high beam currents. The scanning detector will use two light guide tubes in coincidence to eliminate background. To scan in the focal plane, the scanner and will be mounted on a robotic 2D motion assembly. Background and accidental coincidence rates on the detector were simulated, and a laser position detection system for the robotic assembly was designed and constructed. The results of these projects and the current status of the scanner will be discussed.
DA.00015 Application of Different Similarity Renormalization Group Transformations to Nucleon-Nucleon Interactions

This work was supported by a REU supplement to the National Science Foundation Grant No. PHY-0354916.

DA.00016 Improvements of the Focal Plane of SASSYER

This work is partially supported by a grant from the University of South Carolina Magellan Scholar Program.

DA.00017 Neutron Single Particle Strengths in Z=20,22,24 Isotopes

This work is partially supported by a grant from the University of South Carolina Magellan Scholar Program.

DA.00019 Preliminary CLAS 12 Simulation Analysis and Optimization

This work is partially supported by a grant from the University of South Carolina Magellan Scholar Program.

DA.00020 Dual-axis, Duo-lateral Position Sensitive Detectors

2007 Texas A&M Cyclotron Institute REU.

DA.00021 Identification of Upsilon Particles Using the Preshower Detector in STAR

This work is partially supported by a grant from the University of South Carolina Magellan Scholar Program.
DA.00022 Modeling a Carbon Diagnostic System Using MCNPX
S. H. FAY, C. M. KUHN, E. E. SMITH, S. L. STEPHENSON, Gettysburg College, T. C. SANGSTER, V. GLEBOV, LLE University of Rochester, S. J. PADALINO, SUNY Geneseo — MCNPX is currently being used to model various carbon diagnostic configurations for use at OMEGA with plans to design a similar system for the National Ignition Facility (NIF). The purpose of such models is to optimize the carbon diagnostic’s detection of signature products (i.e. tertiary neutrons) from a self-sustaining inertial confinement fusion (ICF) implosion. Results will be presented.

DA.00023 Development and Testing of $Q^\text{Weak}_{W^\gamma}$ Luminosity Monitors
KEVIN FINELLI, Virginia Tech — Building on advances in recent parity experiments at Jefferson Lab, the opportunity exists to make the first precision measurement of the weak charge of the proton, $Q^\text{Weak}_{W^\gamma}$. The $Q^\text{Weak}_{W^\gamma}$ experiment will measure the asymmetry in the scattering of longitudinally polarized electrons on a liquid hydrogen target. The luminosity monitors, placed at forward scattering angles, will be used for monitoring sources of false asymmetry and target density fluctuations. The luminosity monitors will consist of an array of Cerenkov quartz coupled to photomultiplier tubes by air light guides. It is therefore essential to quantify the linearity of the response of the luminosity monitor PMTs. This is being tested with a small asymmetry and a complete electronics chain designed to mimic experimental conditions. Additionally, the air light guides are being constructed and tested for transmission efficiency using cosmic ray events incident on the quartz Cerenkov radiators.

DA.00024 Jet Measurements for QGP Experiments at CMS
S. SAMUEL FLETCHER, Princeton University — Since the 1980s, experimentalists have sought to create in heavy ion collisions a new form of matter called quark-gluon plasma (QGP), where the constituent quarks of highly energetic hadrons become deconfined amidst large quantities of gluons. Measurements of the QGP can serve not only as a test of non-perturbative aspects of quantum chromodynamics, but also illuminate the properties of the early universe, which is believed to have existed as a QGP at the first few microseconds after the Big Bang. We propose a new measurement with the Compact Muon Solenoid at the Large Hadron Collider that uses the dilepton decay of $Z^0$ bosons to tag jets electromagnetically. Di-leptons are unhindered by the QGP’s strong color field, and thus allow for direct, model-independent measurements of jet energy loss. I will present first studies of experimental feasibility of measuring the $Z^0$ signal and identifying the associated background.

DA.00025 Effects of High Count Rates and Pulse Pileup in Sodium Iodide Scintillation Detectors
E. FLUMERFELT, M. SALVITTI, J. BORGARDT, Juniata College, J. ROBINSON, Pacific NW Natl Labs, JUNIATA COLLEGE COLLABORATION — Count-rate saturation and distortion of spectral features. In these situations, isotope identification algorithms may experience problems such as additional or different sources being detected, or failure to recognize present isotopes. Experimental results were compared to MCNP simulations of the data. One of the ASPs tested has some compensation for high-count effects, and does not show these effects. The other ASP displayed signs of peak shifting but very little measurement of jet energy loss. I will present first studies of experimental feasibility of measuring the count-rate saturation and distortion of spectral features. In these situations, isotope identification algorithms may experience problems such as additional or different sources being detected, or failure to recognize present isotopes. Experimental results were compared to MCNP simulations of the data. One of the ASPs tested has some compensation for high-count effects, and does not show these effects. The other ASP displayed signs of peak shifting but very little evidence of spectral marring. The NaI logs however, exhibited spectral distortion and peak shifting under conditions of pulse pile-up. These results provide foundational information in assessing how these detectors respond to potential saturation scenarios.

DA.00026 Parallel plate ionization chamber in low pressure helium gas
D. FRANK, A. HEINZ, R. WINKLER, J. QIAN, R. J. CASPERSON, J. R. TERRY, Wright Nuclear Structure Lab, Yale University — A parallel plate ionization chamber was constructed for beam intensity monitoring. The chamber is placed in a gas-filled volume 1.5m upstream from the gas-filled separator SASSYER. Its output current will be used to determine absolute reaction cross sections. In a dedicated test experiment with a 100 MeV $^3$He beam and an applied potential of 300V, the signal current had an average standard deviation of 0.4%, and demonstrated a linear relationship ($R^2=0.9894$) with the beam intensity. Also, at an intensity of 6 particle nanoamperes, the current exhibited a linear dependence ($R^2=0.9813$) on voltage, indicating that the chamber was operating in the proportional counter region. Our results agreed well with predictions made using extrapolated Townsend coefficients, though we observed a constant systematic and constant deviation between these estimates and our output current. This work was supported under US DOE grant number DE-FG0291ER-40609 and the Yale College Dean’s Fellowship for Research in the Sciences.

DA.00027 Biases in Peak Fitting for Low-Statistics Data
DANIEL GARLAND, Michigan State University — In many areas of physics, the result of a measurement is a peak (signal) on top of a background (noise). For example in nuclear physics, the energies and intensities of γ-rays emitted by excited nuclei are important experimental observables. To extract this information from measured energy spectra, the peaks that correspond to the detection of de-excitation γ-rays are fitted with mathematical functions, for example with Gaussians. When a mathematical function is fitted to experimental data, the fitting method may introduce a significant bias on the estimated parameters. This is particularly important for low-statistics data, in which case the possible biases must be determined since they might introduce large uncertainties. In present work, Monte Carlo simulations of Poisson distributed data of a Gaussian peak with an exponential background are fitted with different methods and the results are compared to the true spectra to determine the biases. The different fitting methods analyzed with respect to the Gaussian peak and background involve χ² statistics and maximum likelihood methods. The Monte Carlo analysis shows a significant bias of the peak fitting for one of the most important parameters, the area of the peak.

DA.00028 Parameterization of Polarized $^3$He Quasi-Elastic Scattering Cross Sections
OCTAVIAN GEAGLA, University of Virginia, JEFFERSON LAB HALL A COLLABORATION — Radiative corrections are important steps when extracting scattering cross sections from data. In order to apply radiative corrections to the $^3$He nucleus, an accurate parameterization of these cross-sectional data in a wide kinematic range are needed. There exist no world parameterizations for the polarized quasi-elastic scattering cross-sections for the $^3$He nucleus, but instead data from other nuclei are combined with theoretical predictions for the polarized $^3$He nucleus. However, $^3$He nuclear effects are neglected. This can lead to large uncertainties in the results. In order to perform the parameterization, various computational methods were used to create a physical model of the scattering which would not neglect the $^3$He nuclear effects. The Jefferson Lab National Accelerator Facility data were fit to various nonlinear distribution models and the best fits were found for each beam energy. A global fit was created by fitting the parameters of these distributions. These results can be used to predict polarized quasi-elastic cross sections for unmeasured kinematics and for applying radiative corrections where such parameterizations are needed.
DA.00029 Determining Neutron Multiplicity in MoNA. J. GILLETTE, M. GARDNER, A. REED, W.F. ROGERS, Westmont College, S. MOSBY, NSCL, Michigan State University, MONA COLLABORATION — The Modular Neutron Array, located at the NSCL at Michigan State University, is used in conjunction with the MSU/FSU Sweeper Magnet to study the breakup of neutron-rich nuclei. Fragmentation reactions create particle-unstable nuclei near the neutron dripline which spontaneously breakup by the decay of one or two neutrons with energies that reflect the nuclear structure of unbound excited and ground states. The neutrons continue forward into MoNA where their position and time are recorded, and the charged fragments’ position and energy are measured by the array of detectors following the Sweeper Magnet. The neutron decay energies can then be determined using kinematic reconstruction of the breakup. It is important to distinguish between one- and two-neutron decays in MoNA. We have therefore developed an algorithm that helps determine neutron multiplicity, based on energy and momentum conservation restrictions for single neutrons scattering multiple times in MoNA. Results of this approach to the analysis of $^{12}$Be and $^{13}$Be decay will be presented.

DA.00030 Parity Measurements in $^{79}$Sr and $^{80}$Y. M.A. HALLSTROM, Case Western Reserve University, R.A. KAYE, Ohio Wesleyan University, S.L. TABOR, T.D. BALDWIN, D.B. CAMPBELL, C. CHANDLER, M.W. COOPER, C.R. HOFFMAN, J. PAVAN, M. WIEDEKING, Florida State University, J. DORING, GSI, S.M. GERBICK, Purdue University Calumet, L.A. RILEY, Ursinus College — Recently, a band was suspected to be based on the $[431]1/2^+$ configuration in $^{79}$Sr. This configuration has been shown to correspond to a very highly-deformed shape, but the parity of this band has never been measured directly. The yrast band in $^{80}$Y is expected to have positive parity based on theoretical calculations and systematic evidence collected from other neighboring nuclei, but this has not been confirmed experimentally. Therefore, the goal of this investigation was to measure conclusively the parity of these bands in $^{79}$Sr and $^{80}$Y. The $^{79}$Sr and $^{80}$Y nuclei were produced at Florida State University following the $^{28}$Si + $^{54}$Fe fusion-evaporation reaction at 90 MeV. The linear polarization of the $\gamma$ rays that were emitted from $^{79}$Sr and $^{80}$Y following the reaction were measured based on how they preferentially Compton-scattered in three Clever Detectors. From these measurements, the known parity assignments in $^{79}$Sr were verified, but conclusive parity assignments could not be made for the proposed $[431]1/2^+$ band. However, a firm assignment of positive parity was made for the yrast band in $^{80}$Y, showing that this nucleus is similar in this regard to its odd-odd neighbors.

This work was supported by the National Science Foundation.

DA.00031 Precise $\alpha_K$ Measurement of 346.5 keV Transition in $^{197}$Pt as a Test of Internal Conversion Theory. M. HERNBERG, University of Iowa, JOHN HARDY, NINEL NICA, JOHN GOODMAN, VICTOR IACOB, Cyclotron Institute, Texas A&M University — We have determined the K-shell internal conversion coefficient (ICC) of the 346.5 keV M4 transition in $^{197}$Pt using an HPGe detector at the Texas A&M University Cyclotron. ICCs are used in the study of nuclear decay schemes, branching ratios and transition rates, as well as spin and parity assignments. We have recently been measuring ICCs (in $^{131}$I, $^{137}$Ba, $^{133}$Cs) with the specific purpose of testing the method used to treat the atomic vacancy in calculating ICCs. Previous measurements of the ICC for the 346.5 keV transition in $^{197}$Pt have disagreed significantly from calculated coefficients regardless of the method used to consider the vacancy. This could have indicated some other unknown factor causing a problem in the calculations. Our preliminary result, determined with an uncertainty of 3% is $\alpha_K = 4.24(13)$. This disagrees with previous measurements ($\alpha_K = 4.02(8)$) and is now consistent with the calculated ICCs.

This research was supported by grants from the National Science Foundation and the Department of Energy.

DA.00032 Neutron-Induced Partial Cross-Section Measurements on $^{76}$Ge Motivated by The Majorana Project $0^+\beta\beta$ Decay Search. S. HILDERBRAND, NC Central Univ., E. KWAN, C. ANGELL, B. FALLIN, C.R. HOWELL, A. HUTCHESON, H.J. KARWOWSKI, J.H. KELLEY, A.P. TONCHEV, W. TORNOW, TUNL, D.B. MASTERS, Samford Univ., R.S. PEDRONI, NC A&T State Univ., G.J. WEISEL, Penn State Altoona — The Majorana Collaboration is to study $0^+\beta\beta$ in order to verify that the neutrino is its own anti-particle; and if so, what is the mass of the electron neutrino. Observation of a sharp peak at the $\beta\beta$ endpoint energy will confirm $0^+\beta\beta$ as a decay mode, and determination of the partial width will determine the matrix element which depends directly on the electron neutrino mass. In order to observe and verify the existence of $0^+\beta\beta$, it is important to reduce intrinsic, extrinsic & cosmogenic backgrounds. The Majorana Project will operate with HPGe detectors deep underground to achieve a low-background environment. Recent advances in signal processing and detector design have also enabled scientists to further understand background sources. $\gamma$-ray spectra from the interaction of pulsed mono-energetic neutrons with $^{76}$Ge were measured at TUNL using segmented HPGe clover detectors. The neutron-induced partial cross-sections for $\gamma$ transitions in $^{76}$Ge were measured at $E_n = 8$ and 12MeV.

This research was supported by DOE grant DE-FG02-97ER41033 and NSF-05-523237.

DA.00033 PDF Contributions and Parity Violation at High Bjorken x. TIMOTHY HOBBS, University of Chicago — In recent decades, leptonic deep inelastic scattering (DIS) has been widely used to probe nucleon structure. Despite remarkable success, studies of parton contributions to nuclear structure and behavior have complicated the original picture of a quark-dominated nucleon. Beyond issues of quark–parton structure and behavior of $^{45}$Cl was analyzed through one-proton knockout conducted at the National Superconducting Cyclotron Laboratory at Michigan State University. A fast beam of $^{45}$Cl nuclei was produced from the one-proton knockout reaction $^{9}$Be($^{45}$Cl, $^{44}$S)X. The excited $^{44}$S particles emitted gamma rays that were collected by the Segmented Germanium Array (SeGA). The measured gamma-ray spectrum of $^{44}$S was fitted with GEANT simulations of the gamma-ray response of SeGA in order to extract gamma-ray intensities. A proposal for the level scheme of $^{44}$S will be presented. Knockout cross sections were measured and the momentum distributions of the recoiling $^{44}$S nuclei were analyzed to determine the orbital angular momentum of the proton knocked out.

This work was supported by the National Science Foundation under grant nos. PHY-0600007, PHY-0355129, and PHY-0653323.
DA.00035 High Voltage Breakdown and SQUID Performance for the Neutron Electric Dipole Moment Experiment, CRAIG HUFFER, CHEN-YU LIU, Indiana University, JOSH LONG, Indiana University Cyclotron Facility, MACIEL KARCZ, Indiana University, NEUTRON ELECTRIC DIPOLE MOMENT COLLABORATION — A new search for a permanent electric dipole moment (EDM) of the neutron is underway at the Oak Ridge Spallation Neutron Source. A non-zero EDM would be a signal of time reversal symmetry violation and improve our understanding of the matter-antimatter asymmetry of the universe. The experiment will use a Superconducting Quantum Interference Device (SQUID) to infer the precession of ultracold neutrons held in a superfluid helium bath, in the presence of applied electric and magnetic fields. The experiment’s sensitivity is proportional to the applied electric field. Neither the maximum practical size of the electric field nor the behavior of SQUIDs in proximity to this field are presently understood. Therefore, we have constructed a small prototype (to decrease the cool-down time) to verify that SQUIDs can function in a high voltage environment and when exposed to RF interference. Another goal is to determine what characteristics allow us to maximize the electric field without breakdown. To do this we measure the breakdown voltage in both normal and superfluid helium at a variety of temperatures and (more unusually) at different pressures, as well as test a variety of electrode materials.

DA.00037 Database Design and Data Retrieval for the PHENIX RPC Factory, JUSTINE IDE, Muhlenberg College, PHENIX COLLABORATION — Database Design and Data Retrieval for the PHENIX RPC Factory. Justine Ide, Muhlenberg College, PHENIX 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 goals of RHIC is to discover the origin of the proton spin. Resistive Plate Chambers (RPCs) will be used at PHENIX as a level 1 trigger to select single high transverse momentum muon events from a large background of low transverse momentum muon events. During the assembly of the RPCs, we will be keeping track of information from quality control tests, performance tests and the position each RPC will occupy in the detector. This information will be used for calibrations after the RPCs are installed in PHENIX. Therefore, the information needs to be organized and stored in such a way that it can easily be accessed over the next several years. This will be done through the use of a database that will be accessed both by a program which inputs data automatically from a number of systems and by a web interface that will be used both to input information and access that information at a later date. The structure of the database will be presented as well as the methods that will be used to input the information.

DA.00039 Calibrating Scintillator position measurement for testing RPC modules for PHENIX at RHIC, DANIEL JUMPER, Abilene Christian University, PHENIX COLLABORATION — PHENIX is a large, high-energy experiment at the Relativistic Heavy Ion Collider. One of PHENIX’s many goals is to study the spin structure of the proton through observing W-boson decays from quark- and antiquark interactions in polarized p+p collisions. An upgraded trigger system using Resistive Plate Chambers that are being built for PHENIX will increase the rejection factor of unfavorable events by two orders of magnitude so that this measurement is possible. As these RPCs are manufactured and assembled into larger sections for installation, an important step in quality assurance is testing each module in a cosmic ray test stand triggered by hodoscope. These scintillators will also provide a position measurement, giving us positioning information in directions where the stacked RPCs have low spatial resolution. This poster will focus on the RPC factory database design and the retrieval of the stored information.

DA.00040 New Neutron Capabilities in the 88-Inch Cyclotron at Lawrence Berkeley National Lab (LBNL)1, SIMARJIT KAUR, University of California, Berkeley, M.A. MCMAHAN, Lawrence Berkeley National Lab, L.A. BERNSTEIN, D. SCHNEIDER, Lawrence Livermore National Lab — Two neutron generators - one 14 MeV and one thermal - will be installed at the 88-Inch Cyclotron at LBNL. The 14 MeV (d, t) source has an integrated neutron output of 1011 neutrons/sec at maximum power. The thermal source generates 107 neutrons/sec in a 116 cm2 field. These neutron generators will be used in diagnostic studies and cross section measurements for the National Ignition Facility at LLNL, and will also be utilized for radiation effects testing. The project scope will be presented including facility layout, neutron flux, shielding calculations and timeline. This new capability will add to the versatility of the 88-inch cyclotron facility and provide exciting new opportunities for both basic and applied nuclear science and national space security missions.

DA.00041 DIANNA: Modeling the time dependence of the YAGUAR reactor pulse, D. KAWAMURA, M.R. SCHMIDT, D.A. YAGER-ELORRIAGA, B.E. CRAWFORD, S.L. STEPHENSON, Gettysburg College — A direct measurement of the neutron-neutron scattering length, a_{nn}, can be found from thermal-thermal neutron collisions within the through channel in the aperiodic pulsed YAGUAR reactor. Model the reactor using MCNPX and the visualization code IVIP. Our geometries now include the 12m time-of-flight path, with its complex collimation system. In addition, we analyzed the time dynamics of the neutron field on the moderator wall. This knowledge of the pulse along with the collision modeling is necessary to extract a_{nn} from the detector count rate.

1 Supported by the U.S. Department of Energy under Contract No. DE-AC02-06CH11231.

1This work is supported through NSF grant number 0555652.
DA.00042 From RHIC to LHC: Elliptic and radial flow effects on hadron spectra. GREGORY KESTIN, ULIRICH HEINZ, The Ohio State University — Using (2+1)-dimensional ideal hydrodynamics we investigate the elliptic flow and spectra of pions and protons in peripheral Au+Au collisions as a function of transverse momentum at midrapidity. We also set a hydrodynamic benchmark for $\pi^{+/p}/\Lambda/K^{+}$, and $\Omega/c$ ratios as a function of transverse momentum. Energies of the collisions we investigate range from several GeV (AGS energies) to several TeV (LHC energies).

DA.00043 How Many Degrees of Freedom are Required to Describe Baryon Resonances? JOSEPH KISH, Abilene Christian University, MIPP COLLABORATION — In quark models the number of baryon excited states predicted depends only on the number of degrees of freedom. Standard quark-diquark models describe all the observed resonance states considerably well. However, standard 3-quark models have additional degrees of freedom that predict a greater number of excited states than have been observed. In order to solve the mystery of the “missing baryons”, gain a better understanding of nucleon structure/dynamics and arrive at a consistent quark model, accurate data are essential. Recent proposed upgrades to the Main Injector Particle Production experiment (MIPP) at Fermilab will facilitate baryon spectroscopy by scanning the mass region from 1.5 to 2.5 GeV/$c^2$ while simultaneously measuring elastic and inelastic channels such as $\pi^-p \rightarrow \pi^-n$ and $\pi^-p \rightarrow K^0\Lambda$. A description of MIPP will be presented, including proposed improvements to the DAQ, lower momentum capabilities, additional plastic ball backscatter detector and upgraded veto hodoscope, as well as the theoretical motivation and expected results.

DA.00044 Proposed Radiation Effects Beam Line for the K150 Cyclotron. COURTNEY KNAUP, HENRY CLARK, Texas A&M University — Solar flares, cosmic rays and the Earth’s Van Allen radiation belts serve as natural sources of space radiation. Such ionizing radiation is potentially harmful to the semiconductor components found in space vehicles and orbiting satellites. Aerospace engineers test the performance and durability of space bound materials and semiconductor devices with accelerated beams of heavy ions produced at laboratories on Earth. The recently recommissioned K150 cyclotron at Texas A&M University can provide accelerated beams similar to the ion species and energies experienced in space. A dedicated beam line has been proposed which includes a vacuum testing chamber and an in-air end station. The computer code “Transport” was used to determine the number of electromagnets needed and their optimal positions along the beam line so that both diffuse and focused beam spots can be produced at the target location. A list of ions at energies of 5, 14, 25A MeV/nucleon have been determined that will give experimenters sufficient range and linear energy transfer to test their semiconductor devices.

DA.00045 Exploring Isomeric States near Doubly-Magic 208Pb. ANDREW KNOX, SUJIT TANDEL, PARTHA CHOWDHURY, University of Massachusetts Lowell — The shell model of nuclear structure involves calculating the energy levels of a nucleus in an appropriate attractive potential well. The levels follow a shell structure, with large energy gaps between shells. The number of nucleons required to fill a shell is referred to as a “magic number”. Probing these shell gaps is an important objective of nuclear structure physics, as it tests and allows fine tuning of the potential well. One way to probe the single-particle levels is to examine metastable excited states, known as isomers, near these shell gaps. Using gamma-ray spectroscopy it is possible to deduce decay schemes and half-lives of these isomers, and subsequently infer information about the excitation mechanism and shell gaps. This project consists of establishing half-lives of isomeric nuclei in a region near 209Bi, which has one excess proton over doubly “magic” 208Pb. Excited states at high angular momentum were populated with the ATLAS accelerator facility at Argonne National Laboratory using a 209Bi beam incident on a 248Cu target. The Gammasphere detector array was used for data acquisition.

1Supported in part by USDOE Grant DE-FG-924ER40848 and UMass Lowell Faculty-Student Collaborative Research Grant.

DA.00046 Hohlraum Reactions as a NIF Diagnostic. RICHARD KORZEKWIA, ANNA HAYES, LANL — In Inertial Confinement Fusion (ICF), a capsule containing fuel, typically deuterium and tritium (D-T), is compressed using a pulse of energy. At the National Ignition Facility (NIF), experiments will attempt to achieve ignition using an indirect drive apparatus in which a D-T capsule is placed inside a high-Z hohlraum in order to produce x-rays. One of the primary concerns for ICF is mixing between capsule and fuel, for which there does not currently exist a diagnostic at NIF. With an understanding of the effects of mix on the shape of the neutron spectrum, we can use several different reactions expected to occur within the hohlraum along with radiochemistry to infer some aspects of the neutron spectrum and hence make measurements concerning the level of mix taking place within the capsule. In addition, we may be able to make similar measurements for temperature, $<\rho_J>$, or $<\rho_J>$ asymmetry.

DA.00047 Tailoring a target for transient field measurements of magnetic moments of short-lived excited states with radioactive beams. B. KRIEGER, N. BENZCER-KOLLER, G. KUMBARTZKI, G. GURDHAL, RUGES, C. GROSS, ORNL, R. HATARIK, P. O’MALLEY, S. PAIN, L. SEGEN, Rutgers, A.E. STUCHBERY, Rhodes College, ANDREW KNOX, SUJIT TANDEL, PARTHA CHOWDHURY, University of Massachusetts Lowell — The shell model of nuclear structure involves calculating the energy levels of a nucleus in an appropriate attractive potential well. The levels follow a shell structure, with large energy gaps between shells. The number of nucleons required to fill a shell is referred to as a “magic number”. Probing these shell gaps is an important objective of nuclear structure physics, as it tests and allows fine tuning of the potential well. One way to probe the single-particle levels is to examine metastable excited states, known as isomers, near these shell gaps. Using gamma-ray spectroscopy it is possible to deduce decay schemes and half-lives of these isomers, and subsequently infer information about the excitation mechanism and shell gaps. This project consists of establishing half-lives of isomeric nuclei in a region near 209Bi, which has one excess proton over doubly “magic” 208Pb. Excited states at high angular momentum were populated with the ATLAS accelerator facility at Argonne National Laboratory using a 209Bi beam incident on a 248Cu target. The Gammasphere detector array was used for data acquisition.

DA.00048 Gamma-Ray Spectroscopy of A≈100 Nuclei. J.D. LEBLANC, D.A. MEYER, Rhodes College, A. HEINZ, H. AI, R.J. CASPERSON, WNSL, Yale University, J.L. HUGON, Rhodes College, B. HUBER, WNSL, Yale University, R. LUTTKE, WNSL, Yale University, T. DARMSTAT, E.A. MCCUTCHEAN, J. QIAN, WNSL, Yale University, B. SHORAKA, WNSL, Yale University, University of Surrey, J.K. SMITH, Rhodes College, J.R. TERRY, E. WILLIAMS, WNSL, Yale University — Structural evolution is often characterized as a function of angular momentum, referred to as the E-GOS (E-Gamma Over Spin) method. When investigating a specific nuclide, structural evolution may be described as a function of angular momentum, referred to as the E-GOS (E-Gamma Over Spin) method. An experiment was performed using the ESTU tandem Van de Graaff accelerator at the Wright Nuclear Structure Laboratory at Yale University. Several nuclei in the A≈100 region were populated via the fusion-evaporation reaction $^{95,96}\text{Zr}^{(12,4)\hbox{n}+\gamma}^{108}\hbox{Pd}$. Subsequent gamma ray emissions were detected using the detector array SPECTRE, which is comprised of eight clover-leafed HP Ge crystal detectors. Data were collected at four different beam energies: 66, 68, 70, and 75MeV. The data will be interpreted utilizing the E-GOS method.

This work was supported by DOE Grant DE-FG-91ER40609 and Rhodes CARES.
DA.00049 Study of the Spent Fuel Contribution to the Reactor Antineutrino Spectra Measured in the Daya Bay $\theta_{13}$ Experiment, H. O. LING LI, KARSTEN HEEGER, University of Wisconsin-Madison — The Daya Bay reactor neutrino experiment is a multinational project to study neutrino oscillation by using the antineutrinos released by Daya Bay Nuclear Power Plant and Lingao Nuclear Power Plant in China. The aim of the experiment is to make a precise measurement of the neutrino mixing angle $\theta_{13}$ with a sensitivity of 0.01 in sin$^2(2\theta_{13})$ by measuring the flux and spectrum of electron antineutrinos. We study the variations of the nuclear fuel composition in the reactor and the resulting changes in the antineutrino flux contributed by each fissile isotope throughout the fuel burning process. Experimental data are used to determine parameterizations of the reactor antineutrino energy spectra. By using information on the varying fuel composition and the antineutrino cross-sections, we calculate the antineutrino spectra measured in the eight detectors in the Daya Bay experiment and compare them to the neutrino oscillation effect due to various values of $\theta_{13}$. The uncertainty on the measurement of sin$^2(2\theta_{13})$ due to spent reactor fuel is estimated.

DA.00050 Main Injector Particle Production Veto Hodoscope Upgrade, KERVIN MARSHALL, Abilene Christian University, MIPP COLLABORATION — The Main Injector Particle Production (MIPP) experiment at Fermi National Accelerator Laboratory (FNAL) has multiple goals which include: providing a starting point for the study of non-perturbative QCD and its associated baryon resonances, gaining a better understanding of the propagation of particles in nuclei, and to improve hadronic shower models in collider simulation programs such as Geant. Having completed its initial run, the MIPP experiment is again in the proposal stage to upgrade the detector in order to improve the data acquisition rate and to extend the measurements to lower momenta. During the original run, especially at low momentum, beam halo and spray particles hitting the experiment in coincidence with events of interest caused problems. The existing veto scintillator, a $0.3 \times 0.3$ m panel with a hole in the center for the beam to pass through, was found to be too small in the initial run and thus is rendered even less effective in the upgraded experiment due to the increase of beam intensity and background. Because of this problem a $1.8 \times 1.2$ m veto hodoscope has been constructed from eight $1.8 \times 0.15$ m EJ-200 plastic scintillators, with a notch in the two middle pieces to form a hole to allow the beam to pass through, and 16 photomultiplier tubes to replace the existing panel. The research, design, testing, and assembly of this wall will be presented.

DA.00051 Decay of $^{10}$C excited states above the $2p + 2\alpha$ threshold and the contribution from “democratic” two-proton emission, KEVIN MERCURIO, Department of Physics, Washington University in St. Louis, J. ELSON, Department of Chemistry, Washington University in St. Louis, L.G. SOBOTKA, Departments of Physics and Chemistry, Washington University in St. Louis, L. TRACHE, R.E. TRIBBLE, Cyclotron Institute, Texas A&M University — The decay of $^{10}$C excited states to the $2p + 2\alpha$ exit channel has been studied using an E/A = 10.7 MeV $^{10}$Be beam inelastically scattered from a $^{12}$Be target. Levels associated with the two-proton decay to the ground state of $^8$Be have been observed. These include states at 5.18 and 6.54 MeV which decay by sequential two-proton emission through the long-lived intermediate state of $^8$B. In addition, states at 5.3 and 6.74 MeV were found in which there is no long-lived intermediate state between the two proton emissions. For the 6.57 MeV state, the two protons are preferentially emitted on the same side of the decaying $^{10}$C fragment. Furthermore, preliminary evidence will be presented for an 8 MeV state decaying through the second excited state of $^9$B.

DA.00052 Development and Tests of the LED Calibration System for the Daya Bay Reactor Neutrino Experiment, MELINDA MORANG, DAYA BAY COLLABORATION — The Daya Bay reactor neutrino experiment must measure the neutrino rate and spectrum with very precision. Thus, the detector modules must be carefully calibrated in order to produce reliable data. This study consists of hardware research and development for the LED portion of the detector calibration system, for which a fast timing resolution is key. We used a photomultiplier tube and an E/A = 8.0 MeV $^{12}$C beam to test prototype components, including pulsing electronics, LED pairs, coaxial cable, and an electrical slip ring which produced a light pulse using a DEI PCO-7110 Laser Diode Driver Module and an Industrial Fiber Optics, Inc. IF-E92A 430nm LED in parallel with a 0.12$\mu$H inductor. We determined that the Moog, Inc. electrical slip ring does not significantly distort or widen the light pulse, and the Cooner Wire CW2040-3650F coaxial cable causes only a very small amount of pulse widening. Because these quick pulses are fast enough for use in the calibration system and because the slip ring and coaxial cable are satisfactory, these components are viable options for Daya Bay. Because these components are all commercially available, they would be simpler to use and possibly more reliable than custom-made components. Thus, we have demonstrated that these components are a good option, and we recommend them as the baseline of the LED calibration system for Daya Bay.

DA.00053 HiRA CsI Detector Response to Low Energy Protons1, CHELSEY MORIAH, Ursinus College and Michigan State University — In the upcoming experiment 05133 at the National Superconducting Cyclotron Laboratory at Michigan State University, the High Resolution Array (HiRA) will detect low energy protons in the range of 1-10 MeV. The HiRA has not previously been used to detect protons of this energy range. The detectors will measure the energy resolution of the HiRA telescopes for low energy protons. Using these energies, the output voltages of the telescopes can be calibrated. In addition, the analysis of histograms in conjunction with the angular range of the detectors will measure the energy resolution of the HiRA telescopes for low energy protons.

1Supported by the NSF and MSU REU

DA.00054 Parity Measurements in $^{80}$Sr1, C.S. MYERS, R.A. KAYE, Ohio Wesleyan University, S.L. TABOR, T.D. BALDWINE, D.B. CAMPBELL, C. CHANDLER, M.W. COOPER, C.R. HOFFMAN, J. PAVAN, M. WIEDEKING, Florida State University, J. DÖRING, GSI, S.M. GERBIC, Purdue University Calumet, L.A. RILEY, Ursinus College — Until recently, $^{80}$Sr was thought to possess only positive-parity states, in contrast to many other neighboring nuclei which are known to have negative-parity states. Now there is indirect experimental evidence for negative-parity states, but the parities have not been measured directly. The goal of this study was to finally resolve this long-standing mystery by measuring conclusively the parities of as many excited states in $^{80}$Sr as possible. $^{80}$Sr nuclei were produced at Florida State University following the $^{54}$Fe($^{28}$Si, 2p) and the $^{54}$Fe($^{28}$Si, n2p) reactions at 90 and 110 MeV, respectively. Following the reactions, high-spin states in $^{80}$Sr were populated and data were collected on the resulting cascades of emitted $\gamma$ rays using an array of 10 Ge detectors. The linear polarizations of 31 $\gamma$ rays were measured and many times allowed for the determination of the parity of the parent state that released the $\gamma$ ray. The results have conclusively verified negative parity for one sequence of states, and positive parity for the yrast states.

1Supported by the National Science Foundation and the OWU Summer Science Research Program.
DA.00055 A Study on Position Resolution within Resistive Plate Chambers1, T. NATOLI, University of Illinois at Urbana-Champaign — The PHENIX experiment, which operates at Brookhaven National Laboratory using the Relativistic Heavy Ion Collider, explores the quark-gluon structure within the proton. An upgrade is currently underway to integrate Resistive Plate Chambers (RPC) into the detector setup to act as a trigger for high transverse momentum muons that are often produced from the decay of W-bosons. To understand the performance of the RPCs before their production, a cosmic ray test stand has been assembled at the University of Illinois at Urbana-Champaign to test small scale RPCs. This test stand allows for the measurement of signal strength, position resolution, timing resolution, and two-dimensional efficiencies of the avalanches formed within RPCs. Utilizing the position resolution capabilities of this test stand a variety of readout strip configurations were tested. The results of this study including the position resolution and cluster size of the avalanches produced will be presented.

1 For the PHENIX collaboration

DA.00056 Continuum Hartree-Fock based Random Phase Approximation Description of the Isovector Giant Dipole Resonance for $^{28}$O, $^{60}$Ca and $^{80}$Zr, E. NICA, S. SHALOM, S. HLOMO, Texas A&M University — Calculations of the nuclear response function for the Isovector Giant Dipole Resonance (IVGDR) have been carried out in the past using the discretized Hartree-Fock Random Phase Approximation (HF-RPA). In many cases they contained violations of self-consistency and a large smearing parameter. To avoid any sources of error we carried out a self-consistent HF-Continuum RPA to determine the IVGDR response function in $^{28}$O, $^{60}$Ca and $^{80}$Zr nuclei. We have also examined the free p-h response in the continuum. The main goal of our research was to determine if the low-lying peaks in the response function were due to resonance or particle threshold effects. We have shown that in some cases the enhancements in the response function at low energies are due to threshold effects. We emphasize that in a discretized HF-RPA these peaks are due to threshold effects and not low-lying resonances.

DA.00057 The Development of Algorithms For Neutron-Based Threat Determinations1, M. E. NICHOLS, A. BARZILOV, P. WOLMBLE, I. NOVIKOV, Western Kentucky University Applied Physics Institute — As pulsed fast neutrons bombard a target object, the resultant nuclear reactions allow for elemental analysis by measuring gamma ray energies and intensities specific to each isotope. Our group primarily utilizes this technique to examine the elemental densities of carbon, nitrogen, oxygen and hydrogen to discern threats between inert materials and high explosives. Using Poisson probability distributions to simulate data from the neutron interrogation method, we have developed threat algorithms which couple the nuclear cross-sections of these elements with elemental densities to segregate materials. We will discuss these algorithms and present Receiver Operating Characteristic (ROC) curves for each determination process to express the likelihood of each material being correctly identified.

1 Acknowledgements: This work is supported in part by the Applied Research and Technology Program of Western Kentucky University.

DA.00058 Imaging Energetic Nuclear Particles, C. NIMAM, R. TRIBBLE, Texas A&M Cyclotron Institute — This research project looks at two different kinds of silicon detectors used for imaging energetic nuclear particles. More specifically, we made a comparison of the performance of the 16 resistive strip silicon detector to that of the four corner readout position sensitive silicon detector designed for use in measuring heavy ions in space-based telescopes. We compared the two detector types in their use as target detectors at the end of the Momentum Achromat Recoil Separator (MARS) beam line. The target detectors were used in fine tuning the vertical and horizontal foci of radioactive nuclear beams of $^{16}$O and $^{18}$Ne. We have determined the position resolution capabilities and the response in terms of position linearity of the four corner detector by designing a mask with various hole spacings which was placed in front of the detector. We tested the detector when exposed to an alpha source as well as a radioactive nuclear beam using a variety of shaping times of the amplifier. In the future a smaller four corner readout detector will be used to tune beams at the end of MARS, which have a typical size of about 4mm x 4mm (FWHM). The smaller detector will leave more room in the chamber at the end of the MARS beam line for other equipment.

DA.00059 Segment Energy Calibrations for Segmented Germanium Detectors, R. P. NORRIS, K. STAROSTA, D. WEISSHAB, P. ADKICH, A. CHESTER, A. DUNOMES, D. MILLER, V. MOELLER, C. VAMAN, P. VOSS, Michigan State University — In the Segmented Germanium Array at the National Superconducting Cyclotron Laboratory, Germanium detectors are electronically segmented into 32 sections and a central control. Segment calibrations for this device face several obstacles, including inter-segment coupling for events in which the total energy is shared by more than one segment and cross talk between the electronics that record the events. While often these cases are corrected in methods that do not separate events in multiple segments, this can reduce the available data. In response, a computerized method for calibrating segments has been developed. An offline program matches spectra with a fourth order polynomial fit, correcting for the effects of the nonlinear relation between energy and channel caused by cross-talk. In addition, the program creates parameters for situations resulting from inter-segment coupling. For events in which a γ-ray is recorded in one segment, parameters for all 32 segments are produced in the calibration. For those in which two segments record the same event, 32x31/2 parameters are produced. This procedure can lead to a 70% improvement in statistics.

DA.00060 Combating Nuisance Alarms Caused by the Ship Effect in 3He Based Neutron Detection Radiation Portal Monitors, A. OLIVER, E. BUCKLEY, J. BORGARDO, Juniata College, R. KOZUES, E. SICILIANO, A. SEIFERT, L. WINDSOR, PHENIX COLLABORATION, PNL, JUNIATA COLLEGE COLLABORATION, PNL, COLUMBIA — Ship effect neutrons can present unique challenges in ongoing efforts to interdict illicit nuclear trafficking at border crossings. 3He neutron proportional counters can generate false positives due to these neutron spikes, leading to cumbersome secondary radiation scans. This work explores methods to mitigate these nuisance alarms through a better understanding of how this effect is manifested in different materials, the role of a target’s neutron density, and data analysis techniques to account for its effects. We used a mobile RPM equipped with 3He tubes to detect the neutron flux from several commercial products containing NORM. While neutrons from illicit nuclear sources are Poisson in their frequency distribution, those from background are not. Ship effect neutrons deviated from a Poisson distribution when binned over 0.1 sec time intervals, however when averaged over 2.0 sec intervals the ship effect neutron spikes were washed out, recovering a Poisson distribution. These findings provide underlying knowledge regarding ship effect neutrons emanating from some common bulk materials, and suggest a data analysis algorithm to distinguish between innocent ship effect neutrons and neutron-emitting illegal sources.

DA.00061 Search for New Physics in Long-Lived Particles that Decay to Photons, R. PATEL, Cyclotron Institute Texas A&M University, D. TÖBACK, Texas A&M University — We look for beyond Standard Model physics using a Gauge Mediated Supersymmetry Model, which predicts events where a neutralino decays to a photon and a graviton. We use the new EMTiming system at the Collider detector at Fermilab to measure the delay in the photon arrival time from the Standard Model predicted photon. Depending on the exclusion region of the neutralino mass, the gravitino can be a warm dark matter candidate. We extend the GMSB by a few GeV/c^2 getting closer to a cosmology region where the gravitino mass is such that it is possible for it to have been thermally produced in the early universe. If the gravitinos are too light (<1 keV/c^2) then they can only destroy the nuclei produced during the Big Bang Nucleosynthesis and can lead to a cosmic microwave background that is different from observations. If they are heavy (>1 keV/c^2) then, while they are a warm dark matter candidate, their density can cause the universe to overclose if there is no dilution mechanism.
DA.00062 Analysis of Gamma-Ray Spectroscopy Using the LabVIEW Programming Environment1 — JAMES PHELPS, PHILLIP WOBBLE, DOUG HARPER, ALEXANDER BARZILOV, Western Kentucky University, Applied Physics Institute — The LabVIEW programming language is very popular for creating data acquisition and analysis software. However analysis systems which require a heavy amount of data manipulation and comparison algorithms, such as for spectral analysis, are typically approached with languages such as C. Our goal is to create an analysis system for γ-ray spectroscopy using the LabVIEW programming language. This system will accept data in the form of delimited text and plot the spectra. An algorithm will be implemented to find peaks within the data and identify γ-rays in the spectra by comparing the measured γ-ray intensities with tables containing known γ-ray intensities. By approaching this problem using LabVIEW, which would more typically be used for the acquisition process, we hope to be able to create a more fully-functional and robust software approach to γ-ray spectroscopy in the future.

1Applied Physics Institute, Western Kentucky University, 1906 College Heights Blvd MS 11077, Bowling Green, KY 42101-1107

DA.00063 Characterization of the CDMS Ionization Readout, AARRN PHIPPS, CDMS/UC Berkeley, CDMS COLLABORATION1 — Current cosmological models predict that a large portion of the total mass of the universe, about eighty percent, consists of putative dark matter. Theory predicts this dark matter may be in the form of particles constantly passing through the Earth. A class of these particles may interact with ordinary matter, earning the name weakly-interacting massive particles (WIMPs). The Cryogenic Dark Matter Search (CDMS) aims to directly detect the existence of WIMPs. CDMS has designed ZIP (Z-dependent Ionization & Phonon) detectors which measure phonon production and ionization of an interaction, making it possible to determine the interacting particle. The low-energy threshold of the ZIP detectors is determined by the signal-to-noise ratio of the ionization readout. A characterization of the signal-to-noise ratio of the ionization readout, along with possible modifications for improved sensitivity will be presented.

1Berkeley Group

DA.00064 Astrophysical factor for the CNO cycle radiative capture reaction15N(p,γ)16O, ADELE PLUNKETT, Cyclotron Institute Texas A&M University; Middlebury College — The reaction 15N(p,γ)16O leaks from CN cycle and determines the oxygen isotopes generated in CNO tri-cycle. Direct measurements of the astrophysical S(E) factors for this reaction were reported [1]. The analysis [1] assumes that the reaction is dominated by resonances at Ecm = 312 and 964 keV, and direct capture to the ground state of 16O. The ANC for bound states of 16O have been measured in reaction 15N(N, d)16O [2]. Using these ANCs, the astrophysical factor for 15N(p,γ)16O has been calculated by the R-matrix approach. The proton and α widths of two resonances were determined from the fit to the direct data for 15N(p,α)12C [3] and used to calculate the S(E) factor for 15N(p,γ)16O. Radiative were varied within experimental uncertainty to fit to the direct data for 15N(p,γ)16O. The calculated S(E) factor is S(0) = 38 keVb if we fit the S(E) factor at the resonance peaks; this is significantly smaller than the value S(0) = 64 ± 6 keVb reported in [1]. Hence, one reaction 15N(p,γ)16O occurs for almost 1500 CN cycles, rather than 880 cycles as estimated in [1]. The problem with fitting the data from [1] at resonance peaks and small energies necessitates re-measurement at lower energies of this reaction. [1] Rolfs, C., and Rodney, W.S., Nucl. Phys. A235 (1974) 450. [2] A. Mukhamedzhanov, P. Bem, V. Burjan et al., Phys. Rev. C (will be submitted). [3] A. Redder et al., Z. Phys. A305, 325 (1982).

DA.00065 Detector Optimization for Fermilab E9061 — ALDO RAELIARIAONA, Abilene Christian University, FERMILAB E906 COLLABORATION — The goal of Fermilab experiment E906 is to extend the measurements made by its predecessor, E866/NuSea, whose result contradicted flavor symmetry in the nucleonic sea. E906 will increase the number of D-Y events by approximately a factor of 50. This will result in significantly smaller errors in the region x > 0.2, where statistics for E866/NuSea were limited. We have used two Monte Carlo programs to optimize the E906 detector for acceptance, multiple scattering, and background rates. One is based on GEANT4, the other is a fast Monte Carlo written specifically for D-Y events. The results and methods for each of these will be presented to demonstrate balancing an all-inclusive type model, which can be slow (GEANT), versus a faster M.C. approach that includes only the minimal details of the interactions.

1Supported in part by US DOE.

DA.00066 Tests of spurious levels for neutron or proton resonance data1, R.C. ROLLER, J.F. SHRINER, JR., Tenn. Tech. Univ. — Nuclear level densities are important in a variety of applications. One method of determining these densities near separation energies is the measurement of resonances with either neutron or proton beams. However, experimental limitations often lead to levels being missed or levels being mistakenly included. Resonance levels are believed to be described by random matrix theory (RMT); therefore, the effects on the nearest-neighbor spacing distributions of both missing and spurious levels are known. We have studied via Monte Carlo and maximum-likelihood methods how well the analysis of spacing distributions can provide estimates of the fraction of spurious or missing levels in a set of energy levels. Results will be presented.

1Work supported by US Dept. of Energy under Grant DE-FG02-96ER40990.

DA.00067 Quark recombination in high energy collisions for different energies, STEVEN ROSE, Texas A&M University and Worcester Polytechnic Institute, RAINER FRIES, Texas A&M University & Riken BNL — We examine hadron production in high energy collisions performed at the Relativistic Heavy Ion Collider (RHIC) with different energies, impact parameters, and nuclei. The mechanisms of recombination as well as fragmentation are thus examined across a wider scale of collisions, allowing for extrapolation of their relative contributions to hadron production. The radial flow and volume were seen to be sensitive to changes in energy, impact parameter, and the colliding nuclei.

DA.00068 A search for the decay η' → π⁺π⁻π⁰ in CLAS data, MICHAEL ROSENMAN, MATT BELLIS, CURTIS MEYER, Carnegie Mellon University, CLAS COLLABORATION — The primary decay modes for the η' are π⁺π⁻γ and ρ⁺, with respective branching ratios of 44.5% and 29.4%. The 111 dataset from Jefferson Lab and the CLAS detector contains about 500,000 events of the type ρ⁺ → π⁺π⁻π⁰ where the π⁰ is reconstructed from the former decay mode. Access to relatively large statistics motivated the search for previously unseen decay modes. With the excellent charged track identification that CLAS possess, a search was made for the decay η' → π⁺π⁻π⁰. This decay is listed in the PDG with only an upper limit of a 5% branching ratio at CL=90%. We search for this decay by measuring all charged tracks in the final state and reconstructing the neutral pion. We see no evidence for this decay and present the results of a careful study that shows that η' peaks in this channel are more likely bleed-through from misidentified π⁺π⁻γ decays.
DA.00069 Alpha Particle Scintillation Analysis in High Pressure Argon Using Photomultiplier Tubes, DANIEL SAENZ, REU Student — We may very likely discover dark matter by studying what it is not rather than what it is. By better understanding how ordinary matter interacts with other ordinary matter, dark matter interactions should stand out. That’s why physicists such as my mentor, Dr. James White, are studying the affects of scintillation events due to ionizing high pressure noble gasses with gamma rays, alpha particles, neutrons, and electrons. My project has been using photomultiplier tubes and a high pressure pure argon gas chamber to study scintillation events. We have focused mainly on alpha particles (as well as gamma rays from decaying Cobalt-57 and neutrons from a 4-MeV proton accelerator). The resulting shape of the events, the ratios of secondary to primary scintillation, and the ratios of triplet state to singlet state decay energies helps catalog ordinary matter interactions.

DA.00070 Transmission Profiles of a Mini-Orange Spectrometer for Conversion-Electron Spectroscopy, AXEL SCHMIDT, Yale University, ROMAN GERNHAUSENER, REINER KRUENKEN, ROBERT MUENZER, Technische Universitaet Muenchen — A Mini-Orange Spectrometer (MOS) consists of an orange-type array of 3, 4, or 6 permanent magnets that focus electrons onto a cooled Si-Li detector. At the center of the array is a lead plug for shielding gamma rays and delta electrons. Since electron transmission of an MOS is highly energy dependent - electrons with too much or too little energy are not bent into the detector - measuring transmission as a function of electron energy is an important calibration task, allowing the MOS to make absolute intensity measurements for conversion electron lines. We report a method for calculating the absolute transmission for an MOS using standard calibration sources, as well as discuss the relevance of conversion electron spectroscopy to the study of nuclear structure.

DA.00071 Simulation of the Focal Plane Detection Systems for the study of the 12C(a,g)16O Reaction with St. George Recoil Separator, NOAH SCHROEDER, Valparaiso University — The 12C(a,g)16O reaction is one of the most important reactions in nuclear astrophysics. The lowest energy we have reached is limited by the background in the detectors. To reduce the background, the St. George recoil separator is designed to study the radiative capture reactions with inverse kinematics. One key instrument of the recoil separator is the detection system at the focal plane used to identify the 16O reaction products from the 12C leakage through the recoil separator. Several focal plane detection systems were simulated with SRIM-2006 to determine the optimal conditions for particle identification. These simulations include a time of flight (TOF) and gas ionization chamber (GIC) configuration, as well as a double TOF configuration. Based on the simulation, the best detection solutions are recommended. Non-uniformities in the entrance window of the GIC and in the energy degrader of the double TOF system were also explored, and affect particle identification greatly, suggesting the necessity of tracking components to correct for large scale non-uniformities.

DA.00072 Search for the states in 8B via 7Be + d, LEIF SEGEN, Rutgers, KYUNG YUK CHAE, ORNL, U of TN, DANIEL BARDAYAN, ORNL, JEFF BLACKMON, ORNL, ART CHAMPAGNE, U of NC, J.J. DAS, IUAC, India, RYAN FITZGERALD, U of NC, VALDIR GUIMARAES, U of Sao Paulo, KATE JONES, Rutgers, MICAH JOHNSON, ORAU, RAYMOND KOZUB, TTU, RONALD LIVESAY, CO School of Mines, ZHANWEN MA, CAROLINE NESARAJA, ORNL, U of TN, STEVEN PAIN, Rutgers, MICHAEL SMITH, ORNL, JEFF THOMAS, Rutgers, DALE VISSER, U of NC — The spectroscopy of the light drip-line nuclei provides an important test of nuclear models (e.g., core shell models and cluster models) at the extremes of isospin. Few excited states have been observed [1] in the 8B nucleus, including the mirror of states in 5Li (e.g., the 4+ 8Li state at 6.53 MeV) that may have exotic configurations. We have searched for states in 8B by bombarding a CD2 target with a 7Be radioactive ion beam at ORNL’s Holifield Radioactive Ion Beam Facility. The light charged particles (p, 3He, and 4He) emitted from the decay of 8B were detected in triple coincidence to reconstruct possible excited states in 8B. The present focus is on the analysis of the triple coincidence data. Preliminary results and implications for the 8B level structure will be reported. This work supported in part by the U.S. Department of Energy and the National Science Foundation. [1] D. R. Tilley et al., Nucl. Phys. A 745, 155 (2004)

DA.00073 Dilepton Spectra from Open-Charm Decays in Heavy-Ion Collisions, JIA SHEN, Saint Mary’s College of California: Cyclotron Institute at Texas A&M University, RALF RAPP, Cyclotron Institute at Texas A&M University — In heavy-ion collisions at ultra-relativistic energies, light quarks are quickly thermalized and lose their originally imparted information while heavy quarks, such as charm quarks, take longer to thermalize. Thus, by studying charm quark spectra, we will be able to better understand the interactions in the quark-gluon plasma. In this project we have focused on di-electron invariant-mass spectra from correlated charm decays. We first generated a realistic distribution for the transverse-momentum (pt) spectra of charm and anti-charm quarks. Then we generated the histogram of invariant-mass distributions of electrons and positrons which result from the decay of charm-anti-charm pairs. We tested the sensitivity of the dilepton spectra to slopes in the charm pt spectrum and to different angular distributions of charm pairs. The goal is to analyze how the interactions of single charm quarks reflect themselves in the di-electron invariant-mass spectrum.

DA.00074 Fiducial Volumes for Photons Detected in the Electromagnetic Calorimeters of the CLAS Detector at Jefferson Lab, CHRISTIAN SHultz, ELLIOT IMLER, MIKE VINEYARD, Union College, CLAS COLLABORATION — Fiducial volumes have been determined for photons detected in the electromagnetic calorimeters of the CEBAF Large Acceptance Spectrometer (CLAS) at the Thomas Jefferson National Accelerator Facility. This work is part of a systematic study of neutral meson photoproduction from the proton and light nuclear targets over an incident photon energy range of 0.5 - 1.5 GeV to investigate nuclear medium modifications of nucleon resonances and the meson-nucleon interaction. In this analysis the neutral mesons are reconstructed from their two-photon decay. The fiducial volumes define regions of the calorimeters with full photon detection efficiency. The volumes were determined by examining the photon hit distributions along the different scintillator planes in the sampling calorimeters. The procedure will be described and the results will be presented.

DA.00075 Statistical Analysis of Proton and Neutron Resonance Data, D.J. SISSOM, J.F. SHRINER, JR., Tenn. Tech. Univ., G.E. MITCHELL, North Carolina St. Univ. and TUNL — Random matrix theory (RMT) is thought to describe statistical properties of neutron and proton resonance data. Very strong evidence for this conclusion comes from a 1982 analysis by Haq et al. [1] of the Nuclear Data Ensemble (NDE), a collection of resonance levels from 32 different nuclides. Because newer data are available for many of the nuclides in the NDE, an updated data set is appropriate. We have examined current resonance data for the nuclides in the original NDE as well as for other even-even targets. N(E) "staircase" plots and comparisons of reduced widths with the Porter-Thomas distribution are used as tests of data quality. Of the NDE’s original 35 sequences, we have retained 11 sequences with new data and 10 sequences with the original data. We have also included 5 new sequences from nuclides not included in the original NDE. Several different statistical tests have been performed. Thus far, the data have shown good agreement with expected behavior.

Work supported by the US Dept. of Energy under grants DE-FG02-96ER40990 and DE-FG02-97ER41042.

1Supported by the U.S. Department of Energy under contract number DE-FG02-03ER41252

DA.00076 Transmission Profiles of a Mini-Orange Spectrometer for Conversion-Electron Spectroscopy, AXEL SCHMIDT, Yale University, ROMAN GERNHAUSENER, REINER KRUENKEN, ROBERT MUENZER, Technische Universitaet Muenchen — A Mini-Orange Spectrometer (MOS) consists of an orange-type array of 3, 4, or 6 permanent magnets that focus electrons onto a cooled Si-Li detector. At the center of the array is a lead plug for shielding gamma rays and delta electrons. Since electron transmission of an MOS is highly energy dependent - electrons with too much or too little energy are not bent into the detector - measuring transmission as a function of electron energy is an important calibration task, allowing the MOS to make absolute intensity measurements for conversion electron lines. We report a method for calculating the absolute transmission for an MOS using standard calibration sources, as well as discuss the relevance of conversion electron spectroscopy to the study of nuclear structure.
DA.00076 The production of light p-process nuclei in the outflows from gamma-ray burst accretion disks  
CRYSTAL SMITH, Union College — Elements created through p-process nucleosynthesis are some of the rarest in the universe. Here we examined the outflows from gamma-ray burst accretion disks as a possible site for the production of some light p-process nuclei. We began by using a calculated model of a black hole accretion disk with a mass accretion rate of one solar mass per second, then using a parameterized outflow model we calculated isotropic abundances for various outflow trajectories. We then examined overproduction values for several light p-process nuclei. We found two regions in our parameter space which showed significant overproduction of some of these nuclei. The electron fraction in the outflow material was between 0.4 and 0.5 in the first region of overproduction and over 0.6 in the second region. In the latter, we find that production is aided by neutrino reactions on free nucleons. Our study indicates that outflows from gamma ray burst accretion disks are a promising site for the synthesis of some light p-process nuclei, and that neutrino interactions can play an important role in this nucleosynthesis.

DA.00077 Studies of Polarization Rotation in a Storage Ring1, ERICK SMITH, Northwest Nazarene University, E.J. STEPHENSON, Indiana University Cyclotron Facility — A published proposal for an electric dipole moment search on the deuteron [PRL 96, 214802] requires that the deuteron beam be polarized horizontally in the plane of a storage ring. The beam is vertically polarized at injection and, through the action of an RF solenoid operating for a fixed time, this polarization must be precessed into the horizontal plane. Treating the precession classically, we investigated ramping the solenoid field to reach the precession rate $G_{ν}$. As a limiting case, we also investigated operating at $ν_{c}$ for a fixed time. The parameters for these simulations were taken from recent studies [PRSTAB 8, 099002] at COSY where this scheme will be tested. We have demonstrated that our model can reproduce the results of these studies of deuteron spin flip, including the effects of momentum spread. We show that beam bunching is required to maintain the polarization. Some sensitivity to momentum spread remains at second order, an effect that also contributes to the polarization decoherence time once the polarization is horizontal. 

1Work supported by NSF REU.

DA.00078 Neutron Background Evaluation for Dark Matter Detectors at DUSEL, JASON SPAANS, University of South Dakota, CLEAN/DEAP COLLABORATION — One of the fundamental mysteries of the 21st century is the nature of dark matter in the universe. A study by the National Academies on the Physics of the Universe identifies this phenomenon as one of the most important experimental pursuits of modern science. A compelling explanation requires physics beyond the Standard Model in the form of Weakly Interacting Massive Particles (WIMPs) that could be detected directly as they recoil from massive and ultra-pure detector targets operating deep beneath the Earth’s surface. The Homestake Mine in western South Dakota has been confirmed as the site for the Deep Underground Science and Engineering Laboratory (DUSEL), and the US high energy and nuclear physics communities have indicated a strong intention to play a leading role in future neutrino and dark matter experiments as part of DUSEL programs. The institutions in South Dakota intend to play a key role in the worldwide effort to identify cosmological dark matter at Homestake. The purpose of this project is to identify the neutron-induced backgrounds for the liquid argon detector proposed for the dark matter search.

DA.00079 Diamond Detector for Compton Polarimetry, DOUGLAS W. STOREY, University of Winnipeg, QWEAK COLLABORATION — The $Q_{weak}$ experiment, at Thomas Jefferson National Accelerator Facility, will make a precision test of the Standard Model prediction of the weak mixing angle, $sin^{2}θ_{W}$ . The weak charge of the proton will be determined through parity violating electron-proton scattering and $sin^{2}θ_{W}$ will be extracted from this measurement. Compton polarimetry will be used to measure the longitudinal polarization of the incident electron beam to 1%. In Compton polarimetry, the polarization is extracted from the Compton scattering asymmetry between laser light and electrons polarized parallel and anti-parallel. The asymmetry is measured by detecting the Compton scattered electrons using a bulk semiconductor detector, fabricated from synthetic diamond. Initial prototyping of the diamond detector was successfully carried out and results will be reported. Data acquisition electronics were developed. Additionally, a GEANT simulation was used to model the polarimeter and to perform design studies related to the electron detector.

DA.00080 Development and Testing of a Novel Lanthanum Bromide Scintillation Detector for SPECT Imaging, JONATHAN SUTTON, ERIC L. BRADLEY, STAN MAJEWSKI, JOHN MCKISSON, VLADIMIR POPOV, JAMES PROFFITT, JIANGUO QIAN, MARGARET S. SAHA, ANDREW WEISENBERGER, ROBERT WELSH, AMIR YAZDI, COLLEGE OF WILLIAM AND MARY PHYSICS DEPT TEAM, COLLEGE OF WILLIAM AND MARY APPLIED SCIENCE DEPT TEAM, COLLEGE OF WILLIAM AND MARY BIOLOGY DEPT. TEAM, THOMAS JEFFERSON LAB DETECTOR AND IMAGING GROUP TEAM — A single piece of LaBr$_3$ has been coupled (by Bicron-St Gobain Inc.) to four special position sensitive phototubes (PSPMTs; Hamamatsu, Inc.) to create a novel detector for biological imaging with high sensitivity, very good energy resolution and high spatial resolution. The LaBr$_3$scintillator is coupled to four Hamamatsu H5950 PSPMTs and the resulting detector can be used with parallel beam or pinhole collimation. To reduce the number of active channels, novel readout circuitry has been implemented. In addition, we have applied special techniques to the achievement of spatial uniformity across the 100 mm$^2$ face of the detector. This technique is of special importance at the interfaces of the four square PSPMTs where the continuous scintillator must act to spread the light between the two photosensitive devices due to the reduced sensitivity in these regions. These techniques and results obtained will be described and discussed.

DA.00081 Optimization of a Light Collection System for use in the Neutron Lifetime Project, C. TAYLOR, C. O’SHAUGHNESSY, P. MUMM, A. THOMPSON, P. HUFFMAN, NCSU/NIST COLLABORATION — The Ultracold Neutron (UCN) Lifetime Project is an ongoing experiment with the objective of improving the average measurement of the neutron beta-decay lifetime. A more accurate measurement of $\nu_{c}$ may increase our understanding of the electroweak interaction and improve astrophysical/cosmological theories on Big Bang nucleosynthesis. The current Project is an ongoing experiment with the objective of improving the average measurement of the neutron beta-decay lifetime. A more accurate measurement

DA.00082 Quality Analysis and Control Procedures for the PHENIX RPC Forward Trigger Upgrade, DILLON THOMAS, Abilene Christian University, PHENIX COLLABORATION — The PHENIX detector is located at Brookhaven National Laboratory on the Relativistic Heavy Ion Collider (RHIC) ring 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 single muons that are produced in the decay of W bosons. Before these new chambers can be installed they must pass a series of quality control tests. Simple but effective tests will be performed on internal components of the RPC such as the gas gaps before individual RPC modules are assembled. These tests will yield a pass or fail result for each gas gap. All gaps that pass these tests can then be used in the construction of the RPC modules. Additional tests will be performed on each assembled RPC module. A list of tests, why they are important, and how they are performed, will be presented.
DA.00083 DUSEL Ultra-Low Background Counting Facility, KEENAN THOMAS, The University of South Dakota, DUSEL ULCBOF COLLABORATION — The Homestake Mine in western South Dakota has been confirmed by the National Science Foundation (NSF) as the site for a Deep Underground Science and Engineering Laboratory (DUSEL). Many of the physics, geosciences, and microbiology experiments in the facility will be funded by DOE and NSF, and will benefit the missions of these agencies. In support of these programs, physics faculty in South Dakota and scientists at Lawrence Berkeley National Laboratory have been working together to establish a multidisciplinary research cluster to provide baseline characterization for physics and geosciences/geomicrobiology experiments at the Homestake Mine through an Ultra-Low Background Counting Facility (ULBCoF). The proposed project utilizes two low-background germanium detectors with massive shielding underground to carefully analyze materials for low-background experiments. Low background experiments such as double-beta decay, solar neutrino, geoneutrino, and dark matter must control the purity of all the materials used in the construction of a detector. Measuring such low counting rates is a very challenging task that will be best accomplished by primarily using high purity germanium (HPGe) detectors.

DA.00084 Controls Interfaces for Two ALICE Subsystems1, ROBERT THOMEN, Creighton University — Software for the control of a laser alignment system for the Inner Tacking System (ITS) and for the Electromagnetic Calorimeter (EMC) was developed for the ALICE (A Large Ion Collider Experiment) at CERN. The interfaces for both subsystems use the CERN-standard hardware controls system PVSS (Prozessvisualisierungs- und Steuerungs-System). Software for the ITS has been created to measure the relative alignment of the ITS with the Time Projection Chamber (TPC) so to ensure accurate particle tracking. The ITS alignment system locates laser images in four cameras. The EMC requires several subsystems to be running in order to operate properly. Software has been created and tested for the detector’s high and low voltage systems, and temperature monitoring hardware. The ITS and EMC software specifications and design requirements are presented and their performance is analyzed.

1This work is supported by the Office of Science, US Department of Energy.

DA.00085 Position calibration for a low-energy neutron detector.1, KATIE THORNE, JENNA DEAVEN, CAROL GUESS, GEORGE PERDIKAKIS, REMCO ZEGERS, Michigan Technological University — A low-energy neutron detector array is being developed for use in (p,n) charge-exchange experiments with radioactive beams. The array will consist of 25 plastic-scintillator bars that are capable of detecting neutrons with energies as low as approximately 200 keV. Since the kinematical reconstructing of a (p,n) reaction is performed using the energy and angle information from the neutron, good energy (measured from time-of-flight) and angle resolutions are important. In the initial testing stage, a single scintillator bar is tested using 22 Na and 252 Cf sources. In the presentation, results from these measurements will be discussed, focusing on the angle resolution of the array.

1This work was supported by the NSF (PHY-0606007) and the REU program at Michigan State.

DA.00086 A Scattering Chamber System to Measure Cross Sections of Multiple Star Configurations in Neutron-Deuteron Breakup at 19 MeV1, LOUIS THREATT, BENJAMIN CROWE, LARRY CUMBERBATCH, North Carolina Central University, CALVIN HOWELL, Duke University and TUNL, DIANE MARKOFF, North Carolina Central University — The kinematics of the neutron-deuteron (nd) breakup reaction enable observables to be studied in a variety of exit-channel configurations that show sensitivity to realistic nucleon-nucleon (NN) potential models and three-nucleon force (3NF) models. Rigorous 3N calculations give very good descriptions of most 3N reaction data. However, there are still some serious discrepancies between theory and data. The largest discrepancy observed for nd breakup is for the cross section for the space-star configuration. Several experimental groups have obtained results showing this discrepancy but it is important to note that they all used essentially the same experimental setup and so their experimental results are subject to the same systematic errors. We will discuss a new scattering chamber system that we have developed to measure simultaneously the cross sections of multiple orientations of the star configuration in nd breakup at 19.0 MeV utilizing an experimental technique that is significantly different from the one used in previous breakup experiments.

1This work was supported by USDOE Grant No. DE-FG02-05ER41380.

DA.00087 MINERvA Experiment, IRINA VERGALASOVA, Rutgers University, MINERVA COLLABORATION — The MINERvA experiment at FNAL will make a high statistics study of neutrino scattering on nuclei. Objective is to study nuclear effects on the axial form factor using quasi-elastic scattering from carbon, iron, and lead. We will present an estimate of the sensitivity of the detector to changes in the form factor.

DA.00088 Increased Precision in Gamow Window Calculations for Thermonuclear Reaction Rates, J. TOKIWA, R.L. KOZUB, TTT, M.S. SMITH, ORNL, K.Y. CHAE, UT-K, E.J. LINERFELT, ORNL/UT-K — The simulations of many astrophysical events require the input of thermonuclear reaction rates. These rate calculations involve a numerical integration over the Gamow window for each reaction. Standard codes to calculate rates, such as the tools at nucastrodata.org, utilize a Gaussian approximation to estimate the relative energy range (Gamow window) over which the calculation is performed numerically. This analytic method fails for low Z particles such as d(d, p)t and d(d, n)3He reactions at low temperatures, which are important for Big Bang Nucleosynthesis (BBN). A new FORTRAN code was written and tested that numerically determines the lower energy limit whose contribution to the integration over the Gamow Window is less than 1.0% at a given temperature. The code also determines the Gamow peak energy numerically, instead of using the formula for a constant S-factor. These developments will extend the rate calculation capabilities at nucastrodata.org to include BBN and enhance upcoming features at bigbangonline.org. This research is supported by the U. S. Department of Energy.


DA.00089 Search for Upward Cosmic Rays, EDWARD WHITE, University of Notre Dame, NSCL, ARTEMIS SPYROU, MICHAEL THOENENNEN, NSCL, TOVA YOAST-HULL, Kenyon College, NSCL, MONA COLLABORATION — The Modular Neutron Array, or MoNA, is a detector located at the NSCL that consists of 144 individual scintillator modules. MoNA is designed to detect fast neutrons, and because plastic scintillators were chosen for the detector, MoNA is also capable of detecting cosmic ray muons. Data taken from the muon detection is typically used for calibration purposes, however, at the same time the angular distribution of cosmic ray muons can be measured. The angular distribution of cosmic rays muons is known to be proportional to $\cos^2(\theta)$, measured from the zenith. However, this only applies to angles less than 90°. Events at larger angles have been observed at large underground detectors with intensities reduced by several orders of magnitudes. These events are attributed to cosmic ray neutrinos and show an almost flat angular distribution. We did observe events at angles larger than 90°. The intensity decreases with increasing angles. The origin of these events is not understood, however, before any conclusions can be drawn, all possible sources of background or random coincidences have to be excluded. Work supported by NSF grants (PHY-0606007. PHY-0243709).
DA.00090 238U Fission Ion Chamber for Neutron Dosimetry at the 88-Inch Cyclotron1, BRENT WILSON, PEGGY MCMANAHAN, BRAD BARQUEST, MIKE JOHNSON, Lawrence Berkeley National Laboratory — Efficiency measurements have been conducted for a commercial 238U fission ion chamber, to be used for neutron dosimetry at the 88-Inch Cyclotron at LBNL. Fast, quasi-monoenergetic neutrons in the energy range of 5 to 30 MeV are under development at the facility through deuteron break-up, for radiation effects testing and cross-section measurements for a variety of applications. Through comparisons with absolute fluxes obtained using activation foils, and energy spectra obtained using the time-of-flight method, efficiency for both monoenergetic and white spectrum neutrons can be calculated.

1Supported by the U.S. Department of Energy under Contract No. DE-AC02-05CH11231 and the U.S. DOE National Nuclear Security Administration under Award #DE-FG03-03NA0078 through the University of California, Berkeley, Department of Chemistry.

DA.00091 Time Stability in Detectors for a 1 ppm Measurement of the Positive Muon Lifetime, BRETT WOLFE, MULAN COLLABORATION — The MuLan experiment aims to obtain a 1 ppm measurement of the positive muon lifetime. In a 22 μs measurement window for the muon lifetime, there are considerably more muon decays at the start of the time and less near the end. We will determine if this bombardment of positrons will create a time delay within the detectors. A laser pulse is sent to 24 of the 340 detectors used to make the positive muon lifetime fit. The same pulse is also sent to a reference detector that does not go into the lifetime fit. The laser pulses are used to measure the time difference between the reference detector and the 24 detectors used to make the lifetime fit. If the muon bombardment does make a considerable difference, then graphing the mean time difference for a specific detector vs the time in the measurement period will show a slope. For a 1 ppm measurement, we need to make sure the time difference at the beginning of the period is within 2.2 × 10^{-13} s from the end of the period.

DA.00092 Raman Spectroscopy as a way to determine Ortho to Para Ratio of Deuterium, PATRICK WONG, ALBERT YOUNG, GUILHEM RIBEIL, VIJAY MEHTA, NCSU — A superthermal ultracold (<350 neV) neutron source using a solid Deuterium (D2) crystal is being developed at the NC State University PULSTAR nuclear reactor. Ultracold neutron production in the solid D2 crystal requires that the D2 be in the ortho (total nuclear spin of 0) rotational state, as D2 in the para (spin 1) rotational state interacts with ultracold neutrons by transferring energy to the neutrons. A novel method to determine the ortho/para-D2 ratio is to use Raman spectroscopy to determine the fraction of rotational states in the D2. This project focuses on the design, construction, and ultimate use of a double-grating Raman spectrometer to determine the ratio of ortho-D2 to para-D2. This system is critical to the optimization of the para-to-ortho-D2 converter which produces D2 for the ultracold neutron source. I will present details on the Raman spectrometer’s construction and performance, as well as Raman spectra obtained for air and regular D2 (with 30% para-D2 content).

DA.00093 Photoproduction of eta mesons off protons at CB-ELSA, A. WOODARD, V. CREDE, A. MCEVIGH, Florida State University, CB-ELSA COLLABORATION — QCD-inspired models predict more states in the hadron mass spectrum than have been seen experimentally. Models show that some of these states should be observed in photoproduction experiments, thus providing a sensitive tool to study hadron properties. Baryon resonances have broad, overlapping widths. Photoproduction of η mesons serves as an isospin filter; the η meson has isospin I = 0 and for this reason, isospin conservation guarantees that the Nη final state can only be reached via formation of N+ resonances. Contributions from Δ, Λ, Ξ, Σ states with I = 3/2 are excluded. We used the Crystal-Barrel Detector (CsI(Tl) calorimeter) at ELSA to determine the cross-section of the reaction γp → ηp studying the η in its two neutral decay modes (η → 3π0) and η → γγ for photon incoming energies in the range of Eγ = 850 – 3000 MeV. In this experiment, the Two-Armed Photon Spectrometer (TAPS) was placed in the forward direction. This BaF2 calorimeter serves as a fast trigger and increases the overall angular coverage to essentially the full 4π solid angle. We present differential cross sections for η photoproduction off the proton for (−1 < cosθ^c.m. < 1). Approximately 600,000 events have been identified. Preliminary results of a partial wave analysis are discussed.

DA.00094 Bakelite Surface Resistivity Measurements for Muon Trigger RPCs in PHENIX, RYAN WRIGHT, Abilene Christian University, FOR THE PHENIX COLLABORATION — The PHENIX experiment, at Brookhaven National Lab, studies polarized proton-proton collisions in order to explore the origin of the proton spin. A forward trigger upgrade for the PHENIX detector will provide a first level trigger for high pt single muons produced from the decay of W-bosons. The measurement of spin sorted yields of W’s makes it possible to measure the spin distributions for quarks and anti-quarks in the proton. The muon trigger upgrade will be based on fast Resistive Plate Chambers (RPCs). The RPC gas gaps will be manufactured from bakelite plates. High rate capabilities are a key requirement for the PHENIX muon trigger RPCs and special attention has been given to the bulk and surface resistivity of the bakelite. Due to the manufacturing process for bakelite, the resistivity of the bakelite can vary significantly within a sheet but also between sheets. Large variations in the surface resistivity have a negative effect on rate capabilities and the detector efficiency. I will present a survey of bakelite surface resistivities for a sample of 17 large bakelite sheets to be used for the PHENIX trigger RPC prototypes.

DA.00095 Scintillation Studies of the Mouse Mammary Tumor Virus with 125I, AMIR YAZDI, ERIC BLUE, ERIC BRADLEY, STAN MAJEWSKI, SHIRA MOHAMMED, JIANGUO QIAN, MARGARET SAHA, STEPHEN SCHWORER, JONATHAN SUTTON, ANDREW WEINSENBERGER, ROBERT WELSH, THE COLLEGE OF WILLIAM AND MARY DEPARTMENT OF PHYSICS TEAM, THOMAS JEFFERSON LAB DETECTOR AND IMAGING GROUP COLLABORATION, THE COLLEGE OF WILLIAM AND MARY DEPARTMENT OF BIOLOGY COLLABORATION — We have applied the techniques of scintillation imaging to studies of the mouse mammary tumor virus (M MTV). In these studies, Sodium Iodide Symporter (NIS) transfers the radioactive 125I to the mammary glands of lactating mice and in particular to those mammary glands with visible tumors. These studies have principally been carried out using pixelated scintillators coupled to position sensitive photomultiplier tubes (PSPMTs). More recently, we have initiated such studies with monolithic slabs of LabC, scintillator coupled to an array of PSPMTs. Several techniques of mapping and measuring the development of such tumors have been employed. These will be discussed in detail and preliminary results will be reported.

1Research funded in part by the U. S. DOE, The U. S. NIH (Grant EB000458-02) and The U. S. DOD Breast Cancer Research Program (BC046053)

DA.00096 Efficiency and Multi-Hit Capability Improvements of MoNA, TOVA YOST-HULL, Kenyon College, ARTEMIS SPYROU, MICHAEL THOENESSEN, NSCL, EDWARD WHITE, University of Notre Dame, MONA COLLABORATION — Located at the National Superconducting Cyclotron Lab at Michigan State University, the Modular Neutron Array (MoNA) consists of 144 detectors 2 meters in length stacked in a nine by sixteen block. MoNA is designed to be used with a sweep magnet to detect and study rare nuclei at and beyond the neutron drip line that decay by neutron emission. MoNA can also be used to detect high-energy cosmic-ray muons. Recently MoNA has been relocated and reassembled in order to prove the multi-hit capability of the modular neutron array. When MoNA was relocated, it was set up into four groups of vertical channels instead of one large block. This separation improves the accuracy of identifying two-neutron events from scattered single neutron events. In addition, the new location allows for the columns to be located at different angles increasing the efficiency for larger decay energies. Following the reassembly the array had to be recalibrated in order to calculate timing, energy, and x-position of the neutrons. The relative timing offsets of the individual detectors was performed using cosmic-ray muons. The new setup, with the larger separation of columns between the groups required a new method to determine the offsets between the columns. Cosmic-ray data were taken to record a sufficient number of muons traversing detectors of both of two separated columns. The relative offsets between all columns were then sequentially determined.
DA.00097 Calibration and Performance of the UConn-Yale-PTB-Weizmann-UCL-TUNL O-TPC. ALEXANDER YOUNG, MOSHE GAI, TRISTAN KADING, MOHAMMAD AHMED, HENRY WELLER, VOLKER DANGENDORF, KAI TITTELMEIER, University of Connecticut — An Optical Readout Time Projection Chamber (O-TPC) will be used in an experiment at the HgS facility at Duke University for studying oxygen formation during stellar helium burning. The calibration of the O-TPC was carried out at the LNS at Avery Point prior to installation at TUNL in August 2007. A variety of pre-amplifiers and high voltage power supplies were tested and under stable conditions an energy resolution as good as 3.5% was found in the charge signal. Charge and light gain curves were obtained using a Gd-148 source and a 75 mm diameter PMT placed at approximately 85 cm. These determined the optimal conditions for operating the O-TPC. Under the optimized conditions a CCD camera was used to capture images of single and double tracks of alpha particles from a Gd-148 source. The 3.18 MeV alpha particles yielded tracks containing only 40-50 photo electrons due to the small lens currently in use.

1This research is funded by the Department of Energy grant number DE-FG02-94ER40870.

Friday, October 12, 2007 2:00PM - 4:24PM – Session EA Frontiers in Nuclear Structure Newport News Marriott at City Center Grand Salon I

2:00PM EA.00001 High-Momentum components of the nuclear wave function: access to the core and the tensor parts of the N-N Interaction, ELIEZER PIASETZKY, Tel Aviv University — The combination of inclusive and exclusive electron scattering data from JLab in kinematic regimes that were not reachable before, together with the analysis and interpretation of older data from hadronic reactions at BNL is finally revealing the details of short-range nucleon-nucleon correlations in nuclei. This talk will discuss the experiments involving the two-nucleon knock-out reactions $^{12}$C(e,e'pp) and $^{12}$C(e,e'pn) The most significant result is the demonstration of the dominance of correlated np pairs over pp pairs in the range of relative momenta 300–600 MeV/c. This can be explained in terms of short-range tensor-force dominance. These new results are essential for refining our understanding of the short-range behavior of the N-N force. Moreover, short range pp pairs are manifestation of asymmetric dense cold nuclear matter that can be studied in the laboratory, and are relevant to studying neutron stars.

2:36PM EA.00002 Strangeness in nuclei: new insights into nuclear structure, JOHN MILLENER, Brookhaven National Laboratory — There has been a renaissance in studies of hypernuclei. A series of experiments at KEK and BNL have used the Hyperball Ge array to investigate γ-ray transitions in p-shell hypernuclei with unprecedented precision (∼keV resolution). About 20 γ-ray transitions have been observed, leading to the determination of seven doublet spacings. At Jefferson Lab, there has been a series of experiments demonstrating the feasibility of high-resolution (sub MeV) electroproduction studies of hypernuclei, providing complementary information (and improved resolution) relative to the traditional meson-induced reaction techniques. Each of these programs has new results and substantial planned extensions in the near future. What we have learned, and hope to learn, from this unique window into both nuclear structure and the nature of strong interactions will be reviewed.

3:12PM EA.00003 The Nuclear Physics of Neutron Stars, JORGE PIEKAREWICZ, Florida State University — The neutron radius of a heavy nucleus is a fundamental nuclear-structure observable that remains elusive. Progress in this arena has been limited by the exclusive use of hadronic probes that are hindered by large and controversial uncertainties in the reaction mechanism. The finite nucleus - a system that is 18 order of magnitude smaller and 55 orders of magnitude lighter than a neutron star - may be used as a miniature surrogate to establish important correlations between its skin and several neutron-star properties. Indeed, a nearly model-independent correlation develops between the neutron skin of $^{208}$Pb and the transition density between the liquid mantle and the solid crust in the neutron star. The implications of the proposed purely electroweak Parity Radius EXperiment (PREX) at the Jefferson Laboratory on neutron-star structure will be reviewed and connections to other fields, such as atomic and condensed-matter physics, will be established.

3:48PM EA.00004 Laser Trapping and Probing of Exotic Helium Isotopes, ZHENG-TIAN LU, Physics Division, Argonne National Laboratory; Department of Physics and Enrico Fermi Institute, University of Chicago — We have succeeded in laser trapping and cooling of the exotic helium isotopes, both $^6$He (t$_{1/2}$ = 0.8 sec) and $^8$He (t$_{1/2}$ = 0.1 sec), and have performed precision laser spectroscopy on individual trapped atoms. Based on the atomic isotope shifts measured along the isotope chain $^3$He - $^4$He - $^6$He - $^8$He, and on the precise theory of the atomic structure of helium, the nuclear charge radii of $^4$He and $^8$He are determined for the first time in a method independent of nuclear models. The results are compared with the values predicted by a number of nuclear structure calculations and test their ability to characterize these neutron rich, loosely bound halo nuclei. The $^8$He measurement was performed at ATLAS of Argonne, and the $^8$He measurement at GANIL, France. This work was supported by the U.S. Department of Energy, Office of Nuclear Physics, under Contract No. DE-AC02-06CH11357.

Friday, October 12, 2007 2:00PM - 4:00PM – Session EB Mini-Symposium on the Global Analysis of Spin-Dependent Parton Distributions II Newport News Marriott at City Center Grand Salon III

2:00PM EB.00001 An update on the Next-to-Leading Order perturbative QCD analysis of the spin structure function data, JEHIEL LICHTENSTADT, Tel Aviv University, Israel — We present a next-to-leading order ($\alpha^2_s$) perturbative QCD analysis of the nucleon spin structure function data available from the fixed target deep inelastic scattering experiments. In the analysis we include the most recent available data sets available from CERN, SLAC and DESY. The polarized gluon distribution obtained from this analysis is then compared to the now available direct measurements of polarized gluons from COMPASS and RHIC data on inclusive neutral pions and jets. We also comment on the impact of possible future data from RHIC and the Electron Ion Collider (EIC).

2:36PM EB.00002 ABSTRACT WITHDRAWN —
2:48PM EB.00003 Longitudinal Double Spin Asymmetry and Cross Section for Direct Photon Production at Mid-rapidity in Polarized $\sqrt{s} = 200$ GeV $pp$ Collisions at PHENIX , ROBERT BENNETT, State University of New York at Stony Brook, PHENIX COLLABORATION — Production of direct photons in collisions at RHIC is one of the important $c$-channels PHENIX will employ to determine the polarized gluon distribution. To es tablish the theoretical understanding of this process, we first present the comparison between the direct photon $p_T$ distribution measured at $\sqrt{s} = 200$ GeV collisions, with the perturbative QCD calculations at next-to-leading or next-to-leading order. The extraction of the cross section relies on two techniques: First, purifying our sample by considering only isolated photons as direct photon candidates and second by a statistical subtraction of weighted spectra of known sources of decay photons from the total photon event sample. We then proceed to evaluate the double helicity spin asymmetries, $A_{LL}$, from these data sets and compare with theoretical models. Since the direct photon $A_{LL}$ is linear in $\Delta g$, it is sensitive to both the sign and magnitude of $\Delta g$ and it will even usually be able to serve as a complementary measurement to the $\sin^2 \theta$ analysis. A status of the analysis of data obtained in 2005, based on a luminosity of 2.7 pb$^{-1}$ and polarization 50%, and 2006 with 7.5 pb$^{-1}$ luminosity and 60% polarization will be presented.

3:00PM EB.00004 Longitudinal Spin Transfer of Hyperons in Polarized Proton-Proton Collisions at $\sqrt{s} = 200$ GeV , QINGHUA XU, LBNL, STAR COLLABORATION — The study of the spin content of the nucleon with polarized proton collisions forms one of the main goals of the STAR (Solentorn Tracker At RHIC) spin physics program. The longitudinal spin transfer $D_{LL}$ of the Lambda and anti-Lambda hyperons at large transverse momenta is sensitive to the helicity distribution functions of strange quarks and anti-quarks, and to polarized fragmentation functions. This contribution reports on the measurement of $D_{LL}$ in inclusive $\Lambda$ and $\bar{\Lambda}$ production in longitudinally polarized proton-proton collisions at a center of mass energy of $\sqrt{s} = 200$ GeV. The data were collected in the year 2005 with proton beam polarizations of about 50%, and a sampled integrated luminosity of about 3 pb$^{-1}$. The $\Lambda$($\bar{\Lambda}$) candidates were reconstructed via the dominant decay channel $\Lambda \rightarrow p\pi^- \bar{\Lambda} \rightarrow p\pi^+\pi^-$ at mid-rapidity ($|y| < 1$) using the STAR Time Projection Chamber. Preliminary results on $D_{LL}$ covering transverse momenta up to 4 GeV/c, will be presented together with an outlook on future hyperon spin transfer measurements.

3:12PM EB.00005 The Polarization of Anti-Lambda Produced in $\sqrt{s}=200$GeV Longitudinal Polarized Proton-Proton Collision at PHENIX , RAN HAN, Peking University — The polarization of anti-lambdas produced in pp collisions as a function of rapidity is expected to be sensitive to the polarization of the anti-strange sea of the nucleon and also sensitive to the polarization fragmentation functions. Substantially non-zero and rather large spin transfers have been observed by the FNAL E704 and E665 experiments. But the polarization reactions can be studied for the first time in longitudinal polarized proton-proton collisions at 200 GeV. The data were collected in the year 2005 with proton beam polarizations of about 50%, and a sampled integrated luminosity of about 3 pb$^{-1}$. The $\bar{\Lambda}$($\Lambda$) candidates were reconstructed via the dominant decay channel $\Lambda \rightarrow p\pi^- \bar{\Lambda} \rightarrow p\pi^+\pi^-$ at mid-rapidity ($|y| < 1$) using the STAR Time Projection Chamber. Preliminary results on $D_{LL}$ covering transverse momenta up to 4 GeV/c, will be presented together with an outlook on future hyperon spin transfer measurements.

3:24PM EB.00006 Charm Content in Jets from $p+p$ Collisions at $\sqrt{s} = 200$ GeV , XIN DONG, Lawrence Berkeley National Lab, STAR COLLABORATION — In hadron collisions at high energies, the charm content in jets can be calculated in perturbative QCD. Gluon fusion into heavy flavor pair results in a hard contribution to the fragmentation into charm hadrons, while gluon splitting process results in a soft contribution. We report the measurements of $D^*+^-$ production in jets from $p+p$ collisions at $\sqrt{s} = 200$ GeV with the STAR experiment at RHIC. The measurements give insight in the charm production mechanism, which is of importance to both the heavy ion and spin physics programs at RHIC.

3:36PM EB.00007 New Measurements of the Proton Double-Spin Asymmetries $A_1$ and $A_2$ In and Above the Resonance Region , ROBERT FERSCH, College of William and Mary, CLAS COLLABORATION — The CLAS EG1b experiment in Hall-B at Jefferson Laboratory utilized a polarized electron beam at various (1.6, 2.5, 4.2, 5.7 GeV) energies and polarized frozen NH$_3$ and ND$_3$ targets to measure double-polarization asymmetries of inclusive electron-nucleon scattering. The proton asymmetry $A_1$ has been extracted from the double-spin asymmetry (at 0.15 GeV$/c$, $Q^2 < 2.0$ GeV$^2$). Newly analyzed data at 2.5 and 4.2 GeV allows a more complete integration in $x$ of the $g_1$ structure function than provided by previous analysis, reducing models dependency in the calculation of $G_1$, the first moment of $g_1$. A linear regression of the asymmetries in terms of $\eta \equiv \epsilon \sqrt{Q^2}/(E - \epsilon E')$ also provides a rudimentary measurement of $A_2$ in the region of kinematic overlap for the varying beam energies.

3:48PM EB.00008 Measurements of Double Longitudinal Spin Asymmetry in Dimuon Production at RHIC , MING LIU, Los Alamos National Lab, PHENIX COLLABORATION — One of the main goals of RHIC-SPIN program is to determine the contribution of the polarized gluons to the proton spin. At RHIC energy, it is expected heavy quark (charm and beauty) production is dominated by gluon-gluon interactions, so measurement of double-longitudinal spin asymmetry of heavy quark production in the polarized $p+p$ collisions will allow us to directly probe the polarized gluon distribution inside the proton. The PHENIX experiment collected 7.5 pb$^{-1}$ (beam polarization about 60%) data from year 2006 run, and successfully reconstructed about 30K dimuon $J/\psi$ candidates as well as 100K back-to-back dimuons with invariant mass above 5 GeV. These two probes cover very different kinematic ranges: for the forward $J/\psi$ production, the covered $x$ ranges are, $x_1 \sim 0.2$ and $x_2 \sim 10^{-3}$; for the back-to-back dimuons, $x_1 \sim x_2 \sim 0.1$. In this talk, we present the current status of $A_{LL}$ measurements in the dimuon channels from the PHENIX experiment.

Friday, October 12, 2007 2:00PM - 5:00PM – Session ED Mini-Symposium on Fundamental Neutron Physics II Newport News Marriott at City Center Grand Salon IV

2:00PM ED.00001 Search for a neutron electric dipole moment$^1$, PAUL HUFFMAN, North Carolina State University, NEDM COLLABORATION — The possible existence of a nonzero electric dipole moment (EDM) of the neutron is of great fundamental interest to itself and directly impacts our understanding of the nature of electro-weak and strong interactions. The experimental search for this moment has the potential to reveal new sources of T and CP violation and to challenge calculations that propose extensions to the Standard Model. The goal of the current experimental effort is to significantly improve the measurement sensitivity to the neutron EDM over what is reported in the literature. The experiment has the potential to either measure the magnitude of the neutron EDM or to lower the current experimental limit by two orders of magnitude. Achieving these objectives will have a major impact on our understanding of the physics of both weak and strong interactions. An overview of the experiment and the present status of our R&D effort will be presented.

$^1$supported in part by the US DOE
2:12PM ED.00002 Magnetic Field Finite-Element Calculations for the SNS Neutron EDM Experiment, S. BALASCUTA, R. ALARCON, Arizona State University, B. FILIPPONE, B. PLASTER, R. SCHMID, California Institute of Technology, NDEM COLLABORATION — The nEDM experiment is a new search for the electric dipole moment (EDM) of the neutron with a sensitivity of $10^{-28}$ e·cm at the recently constructed Spallation Neutron Source (SNS). The measurement requires a static magnetic field surrounding two target cells that contain superfluid $^3$He, polarized neutrons and polarized $^3$He atoms. The latter are used as a co-magnetometer and ultracold neutron spin precession frequency analyzer. The applied static magnetic field, $B_0$, is chosen to be about 10 mG resulting in a precession of the magnetic moments for both neutrons and $^3$He nuclei of ~30 Hz. To maintain the polarization of the neutrons and $^3$He atoms, the magnetic field should be very uniform with gradients of the order of 0.1 $\mu$G/cm averaged over each cell volume. A separate requirement on the volume-averaged magnetic field gradient $<\partial B_z/\partial x>$ in the direction of $B_0$ of less than 0.01 $\mu$G/cm is necessary to minimize false EDM signals. In addition, to reduce the influence of ambient magnetic fields an overall magnetic shielding factor of ~$10^7$ is required. We present finite-element calculation results for the complete nEDM static magnetic field configuration including magnetic field gradients and $^3$He relaxation rates.

2:24PM ED.00003 Monte Carlo Simulation of Spin Relaxation due to $v \times E$ effect in nEDM experiment, RICCARDO SCHMID, BRAD PLASTER, BRADLEY FILIPPONE, Caltech, NDEM COLLABORATION — We have simulated the precession of spin-polarized Ultra Cold Neutrons and $^3$He atoms in uniform and static $B$ and $E$ fields and calculated the spin relaxation. The spin relaxation times $T_1$ (longitudinal) and $T_2$ (transverse) of spin-polarized UCN and $^3$He atoms are important considerations in the new measurements of neutron Electric Dipole Moment in the SNS nEDM experiment. The uniform $E$ field creates a motional magnetic field due to the $\vec{v} \times \vec{E}$ effect which combines with collisions with the walls of the holding cell to produce constant variation of the total $B$ field and result in the spin relaxation of the neutron and $^3$He samples. Scattering of $^3$He atoms in $^4$He also results in spin relaxation and is highly temperature dependent. In the SNS nEDM experiment the $B$ field has magnitude of 10 mGauss. The applied $E$ field is parallel to the $B$ field and has a magnitude of 50 kV/cm. We have found the relaxation times for the neutron due to the $\vec{v} \times \vec{E}$ effect to be long compared to holding times and neutron lifetime. On the other hand, the $\vec{v} \times \vec{E}$ effect could be important for $^3$He relaxation times.

2:36PM ED.00004 The $^3$He injection test for the experiment on the neutron electric dipole moment search, XIAOFENG ZHU, Duke University, NDEM COLLABORATION — A non-zero value of the neutron electric dipole moment (nEDM) is a direct consequence of the time reversal symmetry violation. As such it offers new insight into CP violation and has the potential for discovering new physics beyond the Standard Model. A new search for nEDM aiming at an two-order-of-magnitude improvement over the current experimental limit is underway. This new experiment is based on the nuclear magnetic resonance technique. The overall experimental strategy is to form a three-component fluid of ultracold neutrons (UCN) and $^3$He atoms dissolved in a bath of superfluid $^4$He. The goal of the injection test is to study methods of injecting the $^3$He, polarized by an existing and tested atomic beam source, into the superfluid $^4$He and demonstrate that this can be done with acceptable polarization losses. Cryogenic problems associated with the injection apparatus will also be studied. The test will take place at the Los Alamos National Laboratory in the fall of 2007.

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

2:48PM ED.00005 Investigation of Removal of $^3$He from Liquid $^4$He Solution for the Neutron Electric Dipole Moment Measurement, DAVID G. HAASE, ROBERT GOLUB, PAUL R. HUFFMAN, North Carolina State University and Triangle Universities Nuclear Laboratory — The measurement cycle for the proposed experiment to measure the neutron electric dipole moment at the SNS includes the injection and removal of polarized $^3$He, which is used as a comagnetometer in the same 15 liters of superfluid $^4$He which trap the ultracold neutrons. A critical part of the process is the removal of $^3$He atoms at the end of data collection, reducing the $^3$He concentration from $10^{-10}$ to $10^{-12}$ in a period of 100-200 seconds. It is proposed to accomplish the task via diffusion of the $^3$He from the target cell to an evaporator which preferentially removes $^3$He. The efficiency of the process is strongly sensitive to the temperature dependent diffusion rate and vapor pressure of $^4$He as well as the superfluid film flow in $^4$He. We describe the design of this process and initial results from a prototype evaporator implemented at NC State University.

This work is supported through US Department of Energy contracts with LANL and TUNL.

3:00PM ED.00006 $n - \bar{n}$ oscillations in deuterium, BINGWEI LONG, UBIJARAJA VAN KOLCK, Department of Physics, University of Arizona — Neutron-antineutron ($n - \bar{n}$) oscillation requires interactions that change baryon number by 2 units ($\delta B = 2$), hence providing a stage for physics beyond Standard Model. We generalize the pioneer nuclear effective field theory to include $\delta B = 2$ interactions, and examine $n - \bar{n}$ oscillation in vacuum and in nuclei. We provide, in leading order in a controlled expansion, a model-independent link between the $n - \bar{n}$ vacuum oscillation time and the lifetime of deuterium. We compare our result with previous model estimates, and discuss extensions to other nuclei and to subleading orders.

3:12PM ED.00007 Status of the Ultracold Neutron Source at Los Alamos National Lab, R. RIOS, Los Alamos National Lab, FOR THE UCNA COLLABORATION — The ultracold neutron (UCN) source at Los Alamos (LANL) is currently in its third year of operation. High energy neutrons are produced via spallation from the LANSCE 800 MeV proton beam directed onto a tungsten target. These neutrons are then reflected and partially moderated in a Be "flux trap" (surrounded also by a layer of graphite), within which is located a cold polyethylene moderator. A small percentage of the cold neutrons are downscattered within solid deuterium to colder temperatures (1-4 mK) and are then guided to the experimental area through 4-in diameter stainless steel guides. Modifications were made to the source for the 2006 and 2007 run cycles to increase UCN production. This talk will give an overview of the LANL UCN source, it’s current status, and results from the 2006 and 2007 source test runs.

3:24PM ED.00008 Status of the UCNA Experiment: A Measurement of the Neutron Beta-Asymmetry with Ultracold Neutrons, BRAD PLASTER, University of Kentucky and Caltech, FOR THE UCNA COLLABORATION — The UCNA experiment at the Los Alamos Neutron Science Center (LANSCE) has been designed to extract a precise value (goal of 0.2%) for the neutron beta-asymmetry from measurements of the angular correlation between the neutron spin and the electron momentum (the beta-asymmetry) in polarized ultracold neutron beta-decay. Ultracold neutrons are produced by the downscattering of spallation neutrons in a solid deuterium source, spin-polarized via transport through a 7.0-Tesla field, and then directed to the center of a cylindrical decay trap situated within a solenoidal electron spectrometer. A status report on progress towards a first-step measurement of the beta-asymmetry at the ~1% level during the LANSCE 2007 running cycle will be presented.
3:36PM ED.00009 Studies of the Production and Transport of Highly Polarized Ultracold Neutrons for the UCNA Experiment, A.T. HOLLEY, North Carolina State University, UCNA COLLABORATION — The goal of the UCNA experiment is to determine the angular correlation between the electron momentum and the neutron spin (the beta-asymmetry) in neutron decay using polarized ultracold neutrons (UCN). The experimental strategy is to transport UCN into a decay volume through a 7T static magnetic field using the magnetic potential to polarize the UCN. The initial UCN spin can then be reversed via an rf adiabatic spin-flipper in a 1T field region whose gradient is tailored to optimize the adiabatic spin-flipper’s performance. This spin-flipper, which also allows in situ measurement of the UCN depolarization rate, is a resonant ‘bird-cage’ cavity capable of producing rf fields in excess of 5G at 30MHz. In order to minimize the UCN depolarization rate, UCN guides are constructed of diamond-like carbon films on quartz tubing, a technology which has been demonstrated to produce less than $3 \times 10^{-3}$ depolarizations per bounce. The performance of this system will be described, and compared to expectations from detailed Monte Carlo transport models. The implications for high precision measurements of polarized ultracold neutrons will also be discussed.

3:48PM ED.00010 An Experiment for the Precision Measurement of the Radiative Beta Decay Mode of the Free Neutron, R.L. COOPER, T.E. CHUPP, U Michigan, K.J. COAKLEY, M.S. DEWEY, B.M. FISHER, T.R. GENTILE, J.S. NICO, A.K. THOMPSON, NIST, F.E. WIELFELDT, Tulane U, E.J. BEISE, H. BREUER, H.P. MUMM, U Maryland, J. BYRNE, U Sussex — We have completed a measurement of the neutron radiative beta-decay branching ratio to 10% relative standard uncertainty (15-340 keV photons). The goal of the next generation experiment is to perform a precision measurement of the branching ratio and the photon energy spectrum to a few percent. To reduce the statistical and systematic uncertainties, a 12-element detector is being developed to operate in the bore of a superconducting magnet. It consists of 12 inorganic, scintillating crystals coupled to avalanche photodiodes. Results from tests of the detector’s operation and response using a small dewar and external gamma-ray sources will be presented. Monte Carlo modeling of the detector response is necessary to extract the photon energy spectrum and understand systematic effects. We also present a method to examine the consistency of the electron-proton coincidence rate with known properties of neutron beta decay. By improving calibrations and benchmarks, this experiment can better utilize the expected increase in detected events to make an accurate measurement of the branching ratio and photon energy spectrum.

4:00PM ED.00011 Results of the first beam time with the neutron decay spectrometer aSPECT, STEFAN BAEBLER, FIDEAL AYALA GUARDIA, MICHAEL BORG, KLAUS EBERHARDT, WERNER HEIL, GERTRUD KONRAD, RAQUEL MUÑOZ HORTA, YURI SOBOLEV, University of Mainz, IGOR KONOROV, Gerd PETZOLDT, MARTIN SIMSON, OLIVER ZIMMER, Technical University of Munich, FÉRÉNC GLÜCK, Forschungszentrum Karlsruhe, DENNIS RICH, Forschungsneutronenquelle FRM-II — With the neutron decay spectrometer aSPECT we aim to measure the neutron radiative electron correlation coefficient $\alpha$. We had our first test beam time in 2005/06 at the new neutron source FRM-II in Garching. In my talk I want to talk about the results, the systematic effects we found and the ways how to deal with them in later beam times.

1 now at the University of Virginia  
2 now at Institut Laue-Langevin, Grenoble  
3 now at Spallation Neutron Source, Oak Ridge

4:12PM ED.00012 aCORN: An Experiment to Measure the Electron-Antineutrino Correlation in Neutron Decay, A. LAPTEV, I. STERN, C. TRULL, F.E. WIELFELDT, Tulane University, M. LEUSCHNER, G. NOID, E. STEPHENSON, Indiana University, A. KOMÍNÉS, DePauw University, A. BEYLO, B. COLLETT, G. JONES, D. SHAPIRO, Hamilton College, F. BATEMAN, M.S. DEWEY, B. FISHER, P. MUMM, J. NICO, A. THOMPSON, National Institute of Standards and Technology, ROBERT M. WILSON, B. YEROZOLIMSKY, Harvard University, J. BYRNE, University of Sussex, U.K., THE aCORN COLLABORATION — The angular correlation between the beta electron and antineutrino in free neutron beta decay is characterized by the dimensionless parameter $\alpha$ which, when combined with other neutron decay parameters, can be used to determine the $g_N$ and $g_A$ constants and test the validity and self-consistency of the Standard Model. In the new experimental method employed by aCORN, an asymmetry proportional to $\alpha$ is produced in the coincident detection of the electron and recoil proton. This approach has good potential for smaller systematic uncertainties, which are expected to be less than 1% of $\alpha$. After completion of the detailed design, the component construction and testing is in progress. It is expected that integration and a test run will start at the LENS of the IUCF in 2008. The entire aCORN apparatus will move to NIST for a physics run with a cold neutron beam in fall 2008. This project is supported by the National Science Foundation.

4:24PM ED.00013 aCORN Backscatter-suppressing Electron Detector, CARROLL TRULL, Tulane University, aCORN COLLABORATION — A description and status report of the beta spectrometer for the upcoming experiment, aCORN, will be presented. The experiment measures the electron-antineutrino correlation in neutron beta decay. Electron backscatter from the electron energy detector produces a low-energy tail that can cause a large systematic error in the experiment. The spectrometer is designed to veto more than 90% of the backscattered electrons and measure the electron energy with a resolution of better than 20%. A prototype was built and tested, and the final version has now been assembled.

1 National Science Foundation awards PHY-0420563 and PHY-0554474.

4:36PM ED.00014 The Electron Backscatter Background in the aCORN Experiment, G.A. NOID, E.J. STEPHENSON, Indiana University Cyclotron Facility, aCORN COLLABORATION — aCORN is an experiment to measure $\alpha$, the angular correlation between the anti-neutrino and the electron in neutron beta decay. We will use a row of collimators with a co-linear magnetic field to select events with the protons and electrons emerging from the decay region in opposite directions. A comparison of the relative rates for the two groups with the anti-neutrino momentum or time parallel to the electron momentum or time (symmetry which is only related to $\alpha$). Through simulations we discovered a large background associated with electrons backscattering off the proton detector region and then being detected by the beta spectrometer. By moving our proton detector off-axis, we hope to reduce this background to below our goal of less than 1% relative effect on the asymmetry while preserving 100% collimated proton detection efficiency.

3 This work is supported under NSF grants PHY-0420563 and PHY-0457219.

4:48PM ED.00015 Dead layer measurements on diode detectors, AREG DANAGOLIAN, LANL, LIBERTAD BARRON-PALOS, Arizona State University, ANDREAS KLEIN, SCOTT WILBURN, LANL — The goal of the abBA experiment involves coincidence measurements of protons and electrons from the neutron beta decay. While electron detection is rather straightforward, the detection of the protons is complicated due to their low energies. In order to understand the detector response and to determine the lower cut off value for the energy a technique for determining the thickness of the dead layer has been developed. A discussion of the measurement and of the results will be presented.

Friday, October 12, 2007 2:00PM - 4:48PM — Session EE Nuclear Astrophysics II Newport News Marriott at City Center Grand Salon V
2:00PM EE.00001

30.31$^\text{S}$ level structure measured via $(p,t)$ and $(p,d)$ reactions on $^{32}$S, D.W. BARDAKIAN,$^{1}$ J.C. BLACKMON, W.R. HIX, J.F. LIANG, L.F. ROBERTS, M.S. SMITH, ORNL, Z. MA, U. Tenn., R.L. KOZUB, Tenn. Tech. U., K.L. JONES, J.S. THOMAS, Ruges, R.J. LIVESAY, Col. School of Mines, R.P. FITZGERALD, D.W. VISSER, U. North Carolina. — An accurate knowledge of the level structure of $^{30,31}$S above the proton threshold is important for calculating the astrophysical rates of proton capture on $^{30,31}$P respectively. These proton captures affect the Si abundances observed in meteoritic presolar grains and the reaction flow to heavier nuclei in novae. We have studied $^{30,31}$S by bombarding Zn5 targets with $\sim$40-MeV proton beams from the Holifield Radioactive Ion Beam Facility and detecting reaction tritons and deuterons in the Silicon Detector Array (SIDAR). A total of 13(26) states were observed in $^{30,31}$S including 9(17) above the proton threshold. The spins of strongly-populated levels were constrained through a DWBA analysis of the measured angular distributions. The method and results will be presented.

1 ORNL is managed by UT-Battelle, LLC, for the U.S. DOE under Contract No. DE-AC05-00OR22725.

2:12PM EE.00002

The $^{40}$Ca($\alpha,\gamma$) $^{44}$Ti Reaction Using DRAGON$^1$, C. OUELLET, McMaster U., C. VOCKENHUBER, TRIUMF, L.S. THE, Clemson U., L. BUCHMANN, TRIUMF$,^{2}$, J. CAGGIANO, A. CHEN, McMaster U., H. CRAWFORD, TRIUMF, J. D'AURIA, Simon Fraser U., B. DAVIDS, TRIUMF, D. FREKERS, U. of Munster, A. HUSSEIN, U. of North B.C., D. HUTCHEON, TRIUMF, W. KUTSCHERA, VERA, A. LAIRD, R. LEWIS, U. of York, E. O'CONNOR, D. OTTEWELL, TRIUMF, M. PAUL, Racah Institute of Physics, M. PAVAN, J. PEARSON, C. RUIZ, G. RUPRECHT, M. TRINCEK, U. of B.C., B. WALLNER, U. Wien. — $^{44}$Ti is one of the most short-lived nuclei known to be a candidate of explosive nucleosynthesis, a product of a cold freezefront following a core collapse supernova. To understand the production of $^{44}$Ti a key reaction, $^{40}$Ca($\alpha,\gamma$) $^{44}$Ti, has been studied in inverse kinematics using the DRAGON recoil separator located at ISAC/TRIUMF in Vancouver B.C. The coincidence detection of the recoils and $\gamma$-rays coupled with a time of flight technique provided an accurate determination of the excitation function over a range of beam energies of 6.0 – 1.14 MeV/u. Direct measurement of the stopping power permitted an accurate measure of the stellar reaction rate. The excitation function hints towards previously undiscovered resonances and the new rate results in increased $^{44}$Ti production from supernovae judging from prompt $\gamma$-ray studies alone.

Financial support from the Natural Science and Engineering Research Council of Canada is gratefully acknowledged.

2:24PM EE.00003

High precision mass measurement of sulfur near $N = 28^1$, AMANDA PRINKE, NSCL, C. BACHELET, M. BLOCK, G. BOLLÈN, M. FACINA, C.M. FOLDEN III, C. GUENAUT, A.A. KWIAKTOWSKI, D.J. MORISSEY, G.K. PANG, R. RINGLE, J. SAVORY, P. SCHURY, S. SCHWARZ. — High-precision mass measurements have been performed on the neutron-rich sulfur isotopes 40–48S using the Low Energy Beam and Ion Trap (LEBIT) 9.4 T Penning trap at the NSCL. Produced via projectile fragmentation with a 48Ca primary beam, the ions were converted into a low-energy beam via gas stopping and then transferred into a 9.4 T Penning trap mass spectrometer. Mass uncertainties as low as 20 keV have been achieved in a mass region with important nuclear structure effects like the disappearance of the $N=28$ shell closure and the appearance of a strong subshell closure in neighboring $Z=14$. The experiments were of further technical interest because of the type of beams that can be extracted from gas stoppers. Not only atomic sulfur ions but also several molecular radio-molecules were used for the mass determination.

1 Supported by the National Science Foundation Grant # PHY-0110253 and the US Department of Energy Contract # DE-FG0200ER41144.

2:36PM EE.00004

Technique and study of $\beta$-delayed p-decay of proton-rich nuclei$^1$, L. TRACHE, T. AL-ABDULLAH, A. BANU, C. FU, V. GOLOVKO, J.C. HARDY, V.E. IACOB, H.I. PARK, G. TABACARU, R.E. TRIBBLE, Y. ZHAI, Texas A&M University, J. AYSTO, A. SAASTAMOINEN, University of Jyväskyla, Finland, S. WOODS, T. DAVINSON, University of Edinburgh, UK, M.A. BENTLEY, D. JENKINS, University of York, UK. — We developed a technique to measure beta-delayed proton-decay of proton-rich nuclei produced and separated with the MARS recoil separator at TAMU. In particular we studied the case of $^{23}$Al produced in inverse kinematics. Its $\beta$-decay was studied before, using $\beta-\gamma$ coincidence techniques. The states populated in $^{23}$Mg above the proton threshold at $5.3-7580$ keV may proton decay. They are resonances in the proton capture reaction $^{22}$Na($p,\gamma$)$^{23}$Mg, crucially important for the depletion of $^{22}$Na in ONe novae. A setup consisting of a thin Si strip detector (p-detector) and a thick Si detector ($\beta$-detector) was designed. A HpGe detector outside the chamber detected $\gamma$-rays. A rotating energy-degrader was used to implant the source nucleus (from 40 MeV/u) in the middle of the thin p-detector. We have pulsed the beam from the cyclotron, implanted the source, then measured $\beta$-p and $\beta-\gamma$ coincidences off-beam. The technique has shown a remarkable selectivity to $\beta$-delayed charged particle emission and would work even at radioactive beam rates of a few fps.

1 Supported by US DOE.

2:48PM EE.00005

Consequences of Heavy-Ion Fusion Hindrance on Explosive Astrophysical Processes,$^1$ B.B. BACK, C.L. JIANG, R.V.F. JANSENS, K.E. REHM, Argonne National Laboratory. — Recent measurements of sub-barrier fusion of $^{60,61}$Ni+$^{89}$[1], $^{64}$Ni+$^{64}$Ni[2], $^{64}$Ni+$^{100}$Mo[3], and $^{28}$Si+$^{64}$Ni[4], as well as a re-analysis of older data from the literature, has unambiguously demonstrated that fusion cross sections at sub-barrier energies are substantially lower than predicted by present fusion models. Recently it has been proposed that the additional compression energy inside the touching point of the fusing nuclei causes the observed fusion hindrance [5]. A close examination of published data on reactions involving carbon and oxygen isotopes indicates that also these light systems are subject to the sub-barrier hindrance. This renders the standard extrapolations to the even lower energies, which come into play in explosive astrophysical processes, unreliable, and an extrapolation method, which is guided by the observed fusion hindrance, is therefore proposed [6]. This work was supported by the U.S. Department of Energy, Office of Nuclear Physics, under Contract No. DE-AC02-06CH11357. [1] C.L. Jiang et al., Phys. Rev. Lett. 89, 52701 (2002) [2] C.L. Jiang et al., Phys. Rev. Lett. 93, 12701 (2004) [3] C.L. Jiang et al., Phys. Rev. C 71, 44613 (2005) [4] C.L. Jiang et al., Phys. Lett. B640, 18 (2006) [5] S. Misicu and H. Esbensen, Phys. Rev. Lett. 96,112701 (2006) [6] C.L. Jiang et al., Phys. Rev. C 75, 015803 (2007).

3:00PM EE.00006

MANTIS, in Gas-Filled Mode — AMS for nuclear astrophysics at Notre Dame, first results,$^1$ PHILIPPE COLLON, CHRIS SCHMITT, DANIEL ROBERSTON, University of Notre Dame, DALE HENDERSON, BRENT SCHUMARD, Argonne National Laboratory, LARRY LAMM, EDWARD STECH, STEVEN KURTZ, University of Notre Dame. — Over the past 2.5 years the Browne-Buechner spectrometer at the Nuclear Science Laboratory (NSL) at the University of Notre Dame has been renovated and its system upgraded to enable operations in the gas-filled mode. In addition to this, a new position sensitive PPAC detector and ionization counter were developed as the focal plane detector of this system. The upgrade enables operation of the magnet both in the standard as well as in the gas-filled mode for the measurement of specific nuclear reactions of interest in stellar nucleosynthesis. The presentation will focus on the upgrade work that has involved both graduate and undergraduate students as well as the first tests of the system using the separation of the $^{58}$Fe+$^{58}$Ni isobars as a benchmark measurement. First results on $^{40}$Ca($\alpha,\gamma$) $^{44}$Ti as well as the detection of $^{36}$Cl using AMS in conjunction with the gas-filled mode of the MANTIS detector will also be presented.

3:12PM EE.00007

Equation of State of the Nuclear Pasta, JUTRI TARUNA, JORGE PIEKAREWICZ, Florida State University. — Pasta phase — the neutron-rich matter at subnuclear densities present in the core-collapse supernovae and the crust of neutron stars — displays fascinating complex structures. The equation of state and the two-body spin-isospin dependent correlation function in the nuclear pasta are computed via semi-classical Monte Carlo simulation that incorporates a “semi classical” short-range spin-dependent term to simulate Pauli correlations.
3:24PM EE.00008 Spin response for partially magnetized neutron matter. ANGELES PEREZ-GARCIA, Departamento de Física Fundamental, University of Salamanca, Spain — The spin response function is studied for a neutron plasma partially polarized by the existence of a magnetic field, B. By using Skyrme and Gogny interaction potentials we will analyze the monopolar Landau approximation and the modified Lindhard function in the polarized plasma.

3:36PM EE.00009 Logical Aspect of Quantum Tunnelling. SHANTILAIL GORADIA, Gravity Research Institute, Inc. — I am postulating that every particle communicates to the rest of the universe via a quantum mouth as shown in Fig 2, physics/0210040 v3 (What is Fine-structure Constant?). A question is raised “How can it explain quantum tunneling?” The neck like portion of the connection between the particle and its mouth can stretch as it has no classical counterpart of any fixed length. When the mouths of the alpha particle appear outside the potential well as they will do consistent with quantum probabilities, observing particles positioned outside the potential well can create enough force to drag the alpha particle over the peak of the well and outside. There is no constraint of the stretch of the neck, invisible to us. This logic has a potential to throw light on the issue of EPR.

3:48PM EE.00010 Can thermal input from a prior universe account for relic graviton production?: Implications for the cosmological landscape. ANDREW BECKWITH, APS/Contractor, Fermi National Laboratory — The author presents how one can answer if Sean Carroll’s supposition of a pre inflation state of low temperature-low entropy pre inflation state provides a bridge between two models. Note, loop quantum gravity gives us thermal input permitting large scale relic graviton production. Brane world models as constructed by Randall and Sundrum permit the low entropy conditions Carroll and Chen predicted in 2005. Then we make a linkage from the brane world model to the 10 to the 32 Kelvin conditions stated by Weinberg in 1972 as necessary for quantum gravity. Afterwards, we have a transition to Guth style inflation. We also discuss a difference in values of the cosmological constant between a huge upper bound dependent upon temperature, and a lower bound predicted by Barvinsky et al. in late 2006 with the difference in values as an energy input into relic graviton production. This introduce quantization via a shift in values of the Hartle-Hawking wave function from a lower value of zero to one which is set via a cosmological constant 360 times the square of the Planck’s mass.

4:00PM EE.00011 Nuclear Recoil Background Evaluation for WIMP Searches. DONGMING MEI, The University of South Dakota, ANDREW HIME, Los Alamos National Laboratory, CHRISTINA KELLER, ZHONGBAO YIN, The University of South Dakota, CLEAN/DEAP COLLABORATION — Nuclear recoils produced by neutrons, alphas and neutrinos as they scatter from target nuclei are important sources of background which must be considered in WIMP searches. PMTs and other detector components may contribute neutrons which generate a source of background. Alphas on the surface of the vessel can also be a serious issue for some of the experiments. And, neutrino-induced recoils represent a background to low-threshold experiments. We present a comprehensive study of nuclear recoil events induced by neutrons, alpha particle and neutrinos. The sources of neutrons, alphas and neutrinos are discussed. We also show the background reduction techniques for different type of detectors.

4:12PM EE.00012 The implementation of a $4\pi \gamma$-summing method in capture reaction cross section measurements with relevance to astrophysical processes. A. SPYROU, NSCL/MSU, NCSR Demokritos, Athens, Greece, A. LAGOYANNIS, S. HARISSOPULOS, NCSR Demokritos, Athens, Greece, H.-W. BECKER, C. ROLFS, DTL, Bochum, Germany — A new method, employing a $12'' \times 12'' \gamma$-summing single NaI crystal, was developed for cross section measurements of astrophysically relevant capture reactions on medium-mass nuclei. The large volume and the timing response of such a detector enables the summing of all $\gamma$ rays of a capture reaction. As a result, a single peak, the so-called sum peak, arises in the spectra. Its intensity can be used to obtain cross sections of capture reactions, as long as it is corrected for the detector’s sum peak efficiency. This efficiency is highly affected by the multiplicity of the reaction under study. The method enables to first determine this multiplicity, which is then used to derive the corresponding sum peak efficiency by means of Monte Carlo simulations. Cross sections are finally obtained from the sum-peak intensity with an average uncertainty of $\approx 15\%$. The method was first applied to the $^{62}$Ni($\alpha$, $\gamma$)$^{66}$Zn reaction. The results obtained are in excellent agreement with those reported in literature. The new method was also employed to determine cross sections of 23 capture reactions in the Ge–Sb region.

4:24PM EE.00013 Feasibility of Direct $(n, \gamma)$ TOF Experiments on s-Process Branch Points. AARON COUTURE, Los Alamos National Laboratory, RENE REIFARTH, GSI — We have simulated the response of a 4-\pi calorimetric detector to radioactive isotopes on the s-process path. From these simulations, a maximum tolerable sample size has been determined. In addition, the estimated neutron flux needed for a direct time-of-flight measurement on these branch-point isotopes has been determined. These calculations should aid in the planning of future experiments on these critical isotopes. The methodology of the simulations as well as the determination of the maximum sample size will be discussed.

4:36PM EE.00014 Some remarks about the $\beta$-delayed $\alpha$-decay of $^{16}$N. LOTHAR BUCHMANN, G. RUPRECHT, TRIUMF, C.A. BARNES, Kellog Caltech, C. RUIZ, TRIUMF — The $\beta$-delayed $\alpha$-decay of $^{16}$N has been used to restrict the E1 fraction of the ground state in the key $^{14}$C($\alpha$, $\gamma$)$^{18}$O reaction. A review of the measurements is given and new R-Matrix and GEANT calculations are presented to further elucidate the observed $\alpha$ spectra. A clear response tail from scattering of $\alpha$-particles in the catcher foil is observed in these simulations for thick foils. The simulations show that the TRIUMF measurement and those performed at Yale originate from the same underlying spectrum. The R-matrix calculations reveal, in addition, that the S$_{12}$($\alpha$) is relatively insensitive to details of the spectrum. It is concluded that the TRIUMF measurement represents most likely the closest approximation to the natural $\beta$-delayed $\alpha$-decay spectrum of $^{16}$N.

Friday, October 12, 2007 2:00PM - 4:24PM — Session EF Mini-Symposium on Baryon Resonances and Meson Production II

Newport News Marriott at City Center Pearl Salon II

2:00PM EF.00001 Roper transition form factor from Lattice QCD. HUEY-WEN LIN, ROBERT EDWARDS, Jefferson Lab — Experiments at Jefferson Laboratory, MIT-Bates, LEGS, Mainz, Bonn, GRAAL, and Spring-8 offer new opportunities to understand in detail how nucleon resonance ($N^*$) properties emerge from the nonperturbative aspects of QCD. Preliminary data from CLAS collaboration, which cover a large range of photon virtuality $Q^2$ shows interesting behavior with respect to $Q^2$ dependence: in the region $Q^2 \leq 1.5$ GeV$^2$, both the transverse amplitude, $A_{1/2}(Q^2)$, and the longitudinal amplitude, $S_{1/2}(Q^2)$, decrease rapidly. In this work, we attempt to use first-principles lattice QCD (for the first time) to provide a model-independent study of the Roper-nucleon transition form factor.
2:12PM EF.00002 High resolution hypernuclear spectroscopy in a wide mass region, LULIN YUAN, Hampton University, JLAB HKS COLLABORATION — High resolution hypernuclear spectroscopy for medium heavy and heavy hypernuclei will enable us to extract the spin dependent Λ-N interaction beyond p-shell and help us understand the role of strangeness in dense nuclear matter. In the light mass region, hypernuclear spectroscopy by electroproduction will help us understand the effect of Charge Symmetry Broken (CSB) by studying neutron rich hypernuclei and reveal new nuclear structure aspects induced by strangeness. The preliminary results from JLab HKS experiment, which was carried out in 2005, has demonstrated the ability of hypernuclear electroproduction in obtaining high resolution spectroscopy by utilizing high precision electron beam. In this talk, I will present the current updated spectra of $^1\Lambda B$, $^2\Lambda Al$ and $^7\Lambda He$. The experimental setup and spectrometer calibration procedure will also be described.

2:24PM EF.00003 Baryon Resonance Form Factors at High Momentum Transfer, PAUL STOLER, Physics Dept., Rensselaer Polytechnic Institute, Troy, NY 12180, HALL C COLLABORATION, CLAS COLLABORATION — The results of baryon resonance form factor measurements at high momentum transfer conducted at Jefferson Lab’s Hall C and CLAS will be summarized. Special focus will be on the recent measurements of form factors for the $\Delta(1232)$ and $S_{11}(1535)$ resonances, which reach a maximum $Q^2$ of 7 GeV$^2$/c$^2$. The latest results of these experiments will be presented and the connections with other exclusive reactions such as elastic scattering form factors and high $-t$ Compton scattering in terms of common nucleon structure will be shown, and their connection with current theoretical models will be emphasized.

2:36PM EF.00004 Electroexcitation of the $S_{11}(1535)$ and $D_{13}(1520)$ up to $Q^2 = 4.2$ GeV$^2$ from CLAS data, INNA AZNAURYAN, Yerevan Physics Institute and Jefferson Lab, VOLKER BURKERT, Jefferson Lab, VICENŢIU MOKKEV, Jefferson Lab and Moscow State University — We present the helicity amplitudes for the electroexcitation of the resonances $S_{11}(1535)$ and $D_{13}(1520)$ on protons extracted from CLAS data on the $\pi, 2\pi, \gamma + 3\pi$ electroproduction at $Q < 1$ GeV$^2$ and from $\pi + 4\pi$ data at $1.7 < Q^2 < 4.2$ GeV$^2$. The analysis of the $\pi$ and $\eta$ electroproduction data was made using two approaches: dispersion relations and unitary isobar model, which give consistent results. For the first time definite results are obtained for the longitudinal transition amplitudes for these states. Accurate results are also obtained for the transverse transition amplitudes. The results provide stringent tests for existing quark models calculations. None of the models gives a satisfactory description over the entire $Q^2$ range covered by the data.

2:48PM EF.00005 Current status of a coupled-channel partial wave analysis using data from CLAS at Jefferson Lab, MATTHEW BELLIS, Carnegie Mellon University, MICHAEL MCCracken, CURTIS MEYER, MICHAEL WILLIAMS, CLAS COLLABORATION — The non-strange baryon spectrum has been mapped out predominantly by studying $N\pi$ elastic scattering with phase-shift analysis as the tool of choice. While there has been much success with these experimental techniques, the results have fueled debates in the community, most notably regarding the missing baryons problem. Theoretical solutions to this discrepancy appeal to a diquark-system within the baryons or a coupling to states other than $N\pi$. The CLAS detector at Jefferson Lab has turned out high-statistics, photoproduction datasets which are optimal for resolving these issues. However, new analytical techniques may be required to deal with this rich physics sector. The baryon resonances are photoproduced off liquid hydrogen and the CLAS detector allows us to measure a variety of final states. We will have access to $n\pi^+$, $p\eta^0$, $\pi^+\pi^-\pi^0$, $\pi_0\eta$, $\eta\Lambda K^+$ and $\Sigma K^+$ final states. A robust software package has been developed that allows for the fitting of these states individually and in a coupled-channel mode. New techniques have been applied to background subtraction which brings an added level of consistency to the analysis. Polarization information from other experiments is incorporated at fit time to help distinguish potentially ambiguous physics processes by using information outside of the CLAS datasets. An overview of these tools will be presented as well as the current state of the analysis.

3:00PM EF.00006 Beam asymmetry in $\eta$ 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 the $\eta$ meson photoproduction. 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 $\eta$ meson photoproduction. There have been a comparatively smaller number of beam asymmetry measurements for $\eta$ photoproduction. However, these beam asymmetries cover the energy range up to only about $E_\gamma = 1.5$ GeV. I will present preliminary Jefferson Lab CLAS data on beam asymmetry for the $\eta$ meson for energies up to about $E_\gamma = 2.1$ GeV. I will also discuss how the new measurements will be useful in understanding the structure and excited states of the proton.

3:12PM EF.00007 Photoproduction of omega with linearly polarized photons at CLAS, LUCIA CHEN, FRANZ KLEIN, Catholic University of America, CLAS COLLABORATION — The CLAS-g8 running period with linearly polarized photons allowed for the extraction of beam and parity asymmetry for the $\omega\phi$ channel at photon energies between threshold and 2.1 GeV. Although our analysis aims for providing tight constraints on baryon resonances decaying into $\omega\phi$, a by-product is the separation of contributions of natural and unnatural parity-exchange mechanisms. Such a measurement is considered as an important step to parametrize the $t$-channel background for resonant production. The vector meson is identified in the decay mode $\omega = \pi^+\pi^-\pi^0$. The recoil proton was detected in coincidence with two charged pions and the missing $\pi^0$ identified via missing mass. The three-pion mass spectrum shows a strong $\omega$ signal that is enhanced in the forward direction as expected from diffractive and pion-exchange processes. The extracted spin density matrix elements confirm the dominating pion-exchange mechanism for the lower energy points. However, the (preliminary) cross section and asymmetries are not fully consistent with $t$-channel processes: the cross section enhancement at $\cos\theta_{cm} \approx 90^\circ$ and the modulation of the angular distribution of the decay pions indicate the presence of resonant production.

3:24PM EF.00008 Current status of a partial wave analysis of the $\gamma p \to \omega p$ reaction using data from CLAS at Jefferson Lab, MIKE WILLIAMS, Carnegie Mellon University, CLAS COLLABORATION — Relativistic quark models predict strong couplings to $\omega p$, relative to $N\pi$ — for some of the missing $N^*\pi$ states. Previous searches for these states in $\gamma p \rightarrow p\omega$ have relied solely on differential cross section measurements. I will present final differential cross section and $\omega$ recoil polarization measurements obtained from the CLAS g11a dataset. Measurements have been made in 112 $\sqrt{s}$ bins over the range $1.72 GeV < \sqrt{s} < 2.84 GeV$. The quark model predictions, along with the added constraint of the recoil polarization measurements, make $\omega$ photoproduction a perfect candidate for a partial wave analysis. Preliminary PWA results will be presented, including comparisons of published models to our recoil polarization measurements.

1Partially supported by the NSF and DOE
2JLab Hall C
3This work is supported by the U.S. National Science Foundation.
3:36PM  EF.00009  Current status of a partial wave analysis of the $\gamma p \rightarrow K^+\Lambda$ reaction using data from CLAS at Jefferson Lab. Michael McCracken, Carnegie Mellon University, CLAS Collaboration/Jefferson Laboratory Collaboration — Couplings of $N^*$ states to two-body final state have been predicted using relativized quark-model calculations. Though these predictions give couplings to the $K^+\Lambda$ final state that are small relative to the couplings of other final states, the $K^+\Lambda$ channel is an interesting application of partial wave analysis techniques because it couples only to the iso-spin $\frac{1}{2}$ $N^*$ states and the self-analyzing $\Delta$ decay to $\pi^+n$ allows study of the $\Delta$ polarization. We have isolated some $1.6 \times 10^6$ $\gamma p \rightarrow K^+\Lambda$ signal events in the CLAS g11a dataset. The signal is remarkably clean with less than 2% background to total ratio across 95% of the observed $W$ range ($1.63\text{GeV} < W < 2.84\text{GeV}$). I will present preliminary differential cross-section and recoil polarization results from this channel which are consistent with previous CLAS measurements and world data. I will also present the status of the partial wave analysis of the $K^+\Lambda$ channel. We fit using information from the g11a run ($\frac{1}{2}$, $\Lambda$ recoil polarization) as well as double polarization observables from the CLAS g1c run to constrain possible physics models. These polarization observables are a particularly powerful constraint on non-resonant (t-channel) processes.

3:48PM  EF.000010  $\phi$-meson Photoproduction By Using a Beam of Linearly-Polarized. Julian Salamanca, Philip Cole, Idaho State University, CLAS Collaboration — The observables afforded by linearly-polarized photons are of interest in delineating the contributions of the various hadronic processes giving rise to vector meson photoproduction. And in particular, I shall describe how phi meson production affords an incisive tool for exploring the nature of the parity exchange at threshold energies, the strangeness content of proton, as well as extracting signatures for the violation of Okubo-Zweig-Iizuka observation (OZI rule). Our goal will be measure the $\gamma p \rightarrow \phi p$ reaction, with $\phi \rightarrow K^+K^-$, in the photon energy range of 1.7 to 2.1 GeV by using the Coherent Linear Bremsstrahlung Facility in Hall B of Jefferson Laboratory (Newport News, VA). The data were collected during the g8b run in the summer of 2005.

4:00PM  EF.00011  Measurement of inclusive $\Lambda(1520)$ photoproduction on deuteron. Kenneth Hicks, Tsutomu Mibe, Ohio University, Stepsan Stepanyan, Jefferson Laboratory, CLAS Collaboration — The possible observation of the $\gamma n \rightarrow K^-\Theta^+$ reaction in LEPS and non-observation of the reaction $\gamma p \rightarrow K^0\Theta^+$ in CLAS would require a large isospin asymmetry in the cross section. In 2005, Nam, Hosaka and Kim proposed a large isospin asymmetry in the cross section due to the possible absence of a contact term (Kroll-Ruderman term) in production from the neutron of a $\Theta^+$ with spin $3/2$. The $\Lambda(1520)$ is a well-established excited hyperon with spin and parity $J^P = 3/2^-$. If a large isospin asymmetry exists in the $\Theta^+$ photoproduction, then a similar but opposite cross section asymmetry is predicted in the photoproduction of $\Lambda(1520)$ from the proton and neutron $\sigma(n,\Lambda) < \sigma(p,\Lambda))$. This talk will report the measurement of differential cross sections and decay angular distributions for the inclusive reaction $\gamma d \rightarrow \Lambda(1520)X$ at Jefferson Laboratory using the CLAS detector. Data for $\Lambda(1520)$ photoproduction from both proton and neutron targets will be discussed.

4:12PM  EF.00012  Upsilon Production in STAR. Pibero Dawotho, Indiana University Cyclotron Facility, STAR Collaboration — In the hot and dense matter produced in relativistic heavy-ion collisions, the creation of a quark-gluon plasma is expected to suppress their yields. However, the ground state of the Upsilon is not expected to melt at RHIC energies and thus can be used as a standard candle. As a baseline for any estimate of suppression, the production in p+p collisions is mandatory. We present preliminary results on Upsilon production in p+p collisions at $\sqrt{s} = 200$ GeV via the dielectron decay channel in the midrapidity region. A dedicated trigger was used to enhance the Upsilon samples. We compare the results to perturbative calculations and previous measurements as well as present prospects for future analyses and measurements at STAR.

Friday, October 12, 2007  2:00PM - 4:48PM — Session EG Ultra Relativistic Heavy Ion Collisions II New Port News Marriott at City Center Pearl Salon III

2:00PM  EG.00001  Heavy quark energy loss in a dynamical QCD medium. Magdalena Djordjevic, Ulrich Heinz, The Ohio State University — The computation of radiative energy loss in a dynamically screened QCD medium is a key ingredient for obtaining reliable predictions for jet quenching in ultra-relativistic heavy ion collisions. We calculate, to first order in the opacity, the energy loss suffered by a heavy quark traveling through an infinite and time-independent QCD medium and show that the result for a dynamical medium is almost twice that obtained previously for a static medium. A quantitative description of jet suppression in RHIC and LHC experiments thus must correctly account for the dynamics of the medium's constituents [1].


2:12PM  EG.00002  Measurement of the D meson Production through Hadronic Decay Channel at PHENIX. Sergey Butsyk, LANL, PHENIX Collaboration — The Open Charm production have always been considered as one of the unique and unbiased probes to study the properties of the dense matter produced in Heavy Ion collisions at RHIC. PHENIX experiment at RHIC has done a tremendous job of measuring the production rate of the Heavy Flavor particles through their semi-leptonic decay channels. By studying the production in a different colliding systems (p+p, d+Au, Au+Au) we were able to separate both initial and final state effects in nucleon+nucleon collisions at 200 GeV/N. The unanswered question for those measurements was a relative contribution of Open Charm to the mixture of Open Charm and Open Bottom particle decays that different colliding systems (p+p, d+Au, Au+Au) we were able to separate both initial and final state effects in nucleon+nucleon collisions at 200 GeV/N.

2:24PM  EG.00003  Measurement of the Open Charm Cross Section in $\sqrt{s_{NN}} = 200$ GeV Cu+Cu Collisions for the STAR Experiment at RHIC. Stephen Baumgart, Yale University, STAR Collaboration — Because charm is produced during initial gluon fusion it provides a good probe of the early stages of the matter produced in a relativistic heavy ion collision. Deviations from theoretical predictions for heavy ion collisions may show medium effects. STAR has measured charm production in p+p, d+Au, and Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV using semi-leptonic decay channels and in d+Au and Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV using the D$^0 \rightarrow K\pi$ channel. We report on the measurement of D$^0 \rightarrow K^+\pi^-\Lambda(1520)$ in Cu+Cu collisions at $\sqrt{s_{NN}} = 200$ GeV. A transverse momentum spectrum will be shown as well as the extrapolated open charm cross section. The charm cross section in Cu+Cu will be compared to previous experimental results as well as to FONLL theoretical predictions.

2:36PM  EG.00004  D0 measurements in Cu+Cu collisions at $\sqrt{s_{NN}}=200$ GeV. Sarah Lapointe, Wayne State University, STAR Collaboration — The heavy quark production in relativistic heavy ion collisions provides a reference for heavy meson formation, energy loss and collectivity of heavy quarks in nuclear medium. In this talk, we present preliminary results from D0 measurements in minimum bias Cu+Cu collisions at $\sqrt{s_{NN}}=200$ GeV. The measurements are performed using an exploratory analysis trying to optimize secondary vertexing. This provides a basis for future measurements of heavy quark energy loss and collectivity in heavy ion collisions at RHIC.
2:48PM EG.00005 Two-component approach to $J/\psi$ $p_T$-Spectra at SPS and RHIC

3:00PM EG.00006 Determining Relative Contributions of Charm and Bottom to Single Electron Spectra in pp Collisions at RHIC

3:12PM EG.00007 High-$p_T$ $J/\Psi$ production in $p+p$ collisions at $\sqrt{s}=200$ GeV

3:24PM EG.00008 Beam Energy and System Size Dependence of Dynamical Netcharge Fluctuations

3:36PM EG.00009 Transverse momentum broadening of vector bosons in nuclear collisions

3:48PM EG.00010 Physics with the PHENIX muon trigger upgrade

4:00PM EG.00011 Pixel telescope test in STAR at RHIC

4:12PM EG.00012 Heavy Flavor Measurements with FVTX Upgrade Detector at PHENIX
4:24PM EG.00013 Heavy Flavour and calibration of the STAR Preshower Calorimeter. RORY CLARKE, Texas A&M Cyclotron Institute, STAR COLLABORATION — Heavy flavour quarks provide a unique probe into the hot dense deconfined medium expected to form during heavy ion collisions, the Quark Gluon Plasma. One of the signals of this state of matter is the suppression of the J/Psi signal, observed in PHENIX and the SPS. However, this is complicated by the recombination of charm quarks in the medium. A possible signal that would not undergo recombination is the Upsilon and this could be used to complement the J/Psi signal. The wide opening angle of the dilepton decay channel makes the large acceptance of the STAR detector ideal for reconstructing this signal. The preshower detector is part of the STAR Barrel Electromagnetic Calorimeter (BEMC). The BEMC is used to distinguish the STAR tracks in the chamber and measures particle energies via secondary showers that pass through it. The preshower detects the early showering of electrons, which can then be separated from later interacting hadrons. The setup will be discussed along with a tour of the methods used to calibrate signals from this detector. Finally, the increased hadron rejection possible from this detector will be discussed for heavy flavour programs being conducted at RHIC, such as the Upsilon and J/Psi searches.

4:36PM EG.00014 Electron identification at STAR and the Barrel Preshower detector, MATTHEW CERVANTES, Texas A&M Cyclotron Institute, STAR COLLABORATION — The Barrel Electromagnetic Calorimeter (BEMC) in the STAR experiment at RHIC is a sampling lead scintillator consisting of 4800 towers. The data from the first 2 layers of each tower is read out separately and formally defines the Barrel Preshower (BPRS) detector. The BPRS distinguishes between electrons developing a shower early in the calorimeter tower as opposed to interactions that occur beyond these first 2 layers. We will report on the commissioning of the BPRS into the STAR detector and its implementation into an electron-based analysis. We present the standard method of particle identification currently used for electron selection and investigate the effect of using the BPRS detector. Comparison of such an analysis with and without the BPRS will be shown.

Friday, October 12, 2007 2:00PM - 4:36PM – Session EH Instrumentation I, Newport News Marriott at City Center Blue Point I

2:00PM EH.00001 A TPC with optical readout for directional detection of dark matter, HIDEFUMI TOMITA, STEVE AHLEN, Boston University, DENIS DUJMIC, PETER FISHER, ASHER KABOTH, JOCelyn MONROE, GABRIELLA SCIOLLA, MIT, HERMANN F. WELLENSTEIN, Brandeis, RICHARD YAMAMOTO, MIT, BU-MIT-BRANDEIS DARK MATTER GROUP TEAM — A TPC with optical readout has been developed with the goal of detecting the sense and direction of the elastic recoils generated by Dark Matter interactions. The detector, filled with CF4 gas at low pressure, was placed in a low-energy neutron beam and used to record the scintillation light created by the recoiling gas nuclei. The variation of the light intensity observed along the track is due to the decreasing ionization rate. This effect, known as the “head-tail” effect, allows us to determine the direction of the incoming neutrons.

2:12PM EH.00002 Testing Novel, Position-Sensitive Detectors with Alpha-Gamma Angular Correlations, 1 S. LAkSHMI, P. CHOWDHURY, S.K. TANDEL, C.M. WILSON, University of Massachusetts Lowell, S. GROS, C.J. LISTER, Argonne National Laboratory, R. FARREL, M. MCCLESKY, K.S. SHAH, Radiation Monitoring Devices Inc. — We report on our tests of novel, position-sensitive particle and gamma detectors for applications in nuclear physics experiments. We measure the angular correlation between the alpha particle decay of 224Ra to an excited state in 209Rn, and the subsequent gamma decay to the ground state in 209Rn using a 25 mm<sup>2</sup>, <200 micron thick position-sensitive avalanche photo-diode (PSAPD) for detecting the alpha particles and a 20 mm thick, 14x14 planar germanium double-sided strip detector (GeDSSD) for detecting the gamma rays. A large solid angle can be covered in a single, fixed geometry, given the excellent position resolution of the PSAPD (400 microns) and the GeDSSD (5 mm) by positioning the detectors close to the source. Improved distortion correction algorithms for the PSAPD, pixel efficiencies, method of angle reconstruction and the measured angular correlation will be presented.

1Supported by the US Department of Energy.

2:24PM EH.00003 Performance evaluation of novel square-bordered position-sensitive silicon detectors with four-corner readout, A. BANU, Y. LI, M. MCCLESKEY, C.A. GAGLIARDI, L. TRACHE, R.E. TRIBBLE, Cyclotron Institute, Texas A&M University, College Station, TX 77843, M. BULLOUGH, S. WALSH, C. WILBURN, Micron Semiconductor Ltd., 1 Royal Buildings, Marlborough Road, Lancing Business Park, Lancing, Sussex, BN15 6SJ, UK — A new square-bordered type two-dimensional position sensitive silicon detector produced by Micron Semiconductor Ltd. was recently developed in collaboration with Cyclotron Institute at Texas A&M University. It consists of a square-shaped ion-implanted resistive anode framed by an additional square low resistivity strip. The main characteristics of the detectors are given and subjected to series of tests. The device consists of a stack of alternating plastic scintillator (Saint Gobain BC-408) slabs and thin radiator films (PDMS — SYLGARD 184) loaded with 0.5% of Gd per weight, viewed by a photomultiplier tube. The scintillator functions as neutron moderator, provides a prompt gamma decay signal, and detects delayed capture by Gd nuclei via associated capture γ-rays. The design, Monte Carlo simulations carried out with an extended code DENIS(E), as well as first measurements with the detector will be discussed.

2:36PM EH.00004 Neutron Multiplicity Discrimination in MoNA, 1 W.F. ROGERS, J. GILLETTE, M. GARDNER, A. REED, Westmont College, S. MOSBY, NSCL, Michigan State University, MONA COLLABORATION — The Modular Neutron Array (MoNA) is a high-efficiency neutron detector at the National Superconducting Cyclotron Laboratory at MSU, used in conjunction with the NSCL/FSU sweeper magnet to investigate the loss of one or more neutrons from particle-unbound nuclei near and beyond the neutron drip-line. In order to properly analyze data from these experiments it is important to distinguish neutron multiplicity in MoNa. We’ve developed an algorithm that produces scatter plots of neutron velocity change vs. scattering angle and energy deposition vs. scattering angle, each of which results in a locus of events corresponding (largely) to single neutron multiple-scatter events, and each of which can be used to gate the other for cross-correlation. Challenges to accurate neutron trajectory mapping include sub-threshold neutron scattering from carbon (which changes neutron trajectories in unpredictable ways) and the discrete nature of the array, which (especially for shorter scattering lengths) results in scattering angles not necessarily reflective of actual neutron trajectories. Results for experiments involving one and two neutron decays will be presented.

1Work Supported by NSF Grant #PHY-0520104

2:48PM EH.00005 Development of a neutron detector with broad dynamic range and multi-hit capability, IWONA PAWELCZAK, JAN TÖKE, YUN-TSE TSAI, W.UDO SCHRÖDER, University of Rochester Departments of Chemistry and Physics — A new type of Cd-loaded plastic neutron detector with a broad dynamic range (from thermal to MeV range) and multi-hit capability has been designed and subjected to series of test. The device consists of a stack of alternating plastic scintillator (Saint Cobain BC-408) slabs and thin radiator films (PDMS — SYLGARD 184) loaded with 0.5% of Gd per weight, viewed by a photomultiplier tube. The scintillator functions as neutron moderator, provides a prompt integrated neutron energy signal, and detects delayed capture by Gd nuclei via associated capture γ-rays. The design, Monte Carlo simulations carried out with an extended code DENIS(E), as well as first measurements with the detector will be discussed.
Penning trap mass spectrometer design will be given. The preliminary results of the commissioning run will be described and the short-term measurement goals for the TITAN mass spectrometer. It is now being commissioned and is scheduled for its first online mass measurement at the end of August of 2007. An overview of the TITAN Penning trap mass spectrometer is designed to use a variety of ion trapping techniques to conduct nuclear and atomic physics research. It will be used to study short-lived isotopes produced by the fusion-evaporation reaction. The main holding field. These improvements will be discussed.

This $1.8M project is funded by CFI, ORF and TRIUMF.

Investigation of Plastic Scintillator Detector Configurations for Neutron Studies 1. CATALIN MATEI, Oak Ridge Associated Universities, D.W. BARDAYAN, J.C. BLACKMON, Oak Ridge National Laboratory, J.A. HOWARD, Tennessee Technological University, J.A. CIŻEWSKI, P.D. O’MALLEY, S.D. PAIN, W.A. PETERS, Rutgers University, R.K. GRZYWACZ, K.L. JONES, S.N. LIDDICK, University of Tennessee — Plastic scintillation products are widely used for detecting nuclear radiation. Measurements of the response of plastic scintillator detectors to different radiations are important in the design phase of a detection system and as an initial input in Monte Carlo simulation codes. We performed test measurements of the light response, attenuation length, time and position resolution, and detection efficiency of Bicron BC408 plastic scintillator. Four plastic scintillator bars of dimensions 2.9×2.9×60 cm$^3$ and 5×5×200 cm$^3$ have been developed to be used in (d,n) and beta-delayed neutron studies. The detectors were constructed with different reflecting materials, optical couplings and photomultiplier tube assemblies. Measurements are compared with predictions from the Monte Carlo simulation code GEANT4. Details of the experimental configuration and results will be presented.

Three plastic scintillator bars of dimensions 2.9×2.9×60 cm$^3$ and 5×5×200 cm$^3$ have been developed to be used in (d,n) and beta-delayed neutron studies. The detectors were constructed with different reflecting materials, optical couplings and photomultiplier tube assemblies. Measurements are compared with predictions from the Monte Carlo simulation code GEANT4. Details of the experimental configuration and results will be presented.

**References:**


This work is supported in part by the NSF and U.S. Department of Energy under contract numbers DE-FC03-00NA0003 and DE-FG52-03NA00031 (ORNL), and DE-AC05-00OR22725 (ORNL).

Comparison of various Monte Carlo for response-function studies of a plastic detector used in precise branching-ratios experiments, V.V. Golovko, V.E. Iacob, J.C. Hardy, Cyclotron Institute, Texas&M University, College Station, TX 77843, USA, D. MELCONIAN, University of Washington — In order to test the Conserved Vector Current hypothesis of the Standard Model, precise determination of the branching ratios for superallowed $\beta$ transitions is needed [1]. For this purpose, we are using an experimental setup in which one of the main components is a plastic scintillator, and a knowledge of the Response Function (RF) of this scintillator to $\beta$ particles as a function of energy is important. In previous works we compared a Monte Carlo (MC) simulated RF with experiment for $\beta$ particles from standard $\beta$-sources as well as from “on-line” measurements [2]. However, we found that various MC programs predict slightly different results. To investigate this, we created the simplified configurations for the MC programs and studied the RF of a plastic disk to monoenergetic positrons with different energies from a point-like source in the air. We concentrated on an intercomparison between the MC results from physics models of various codes: Geant4, Penelope and EGSsr. For energies between 0.1 MeV to 20 MeV, we see 2% relative differences in the efficiency calculations from different programs. [1] J.C. Hardy and I.S. Towner. PR, 71(5):055501, 2005. [2] V.V. Golovko et al. BAPS 59, no 6, p. DH4 83, 2006; BAPS 52, no 3, p. C16 33, 2007.

Laser Polarized $^3$He Targets, RAHUL BHOJWANI, JEFFERSON LAB HALL A COLLABORATION. JEFFERSON LAB POLARIZED $^3$HE TARGET COLLABORATION — Laser-polarized $^3$He targets using spin-exchange optical pumping (SEOP) are used for studying nucleon spin structure and neutron form factors, among other things. Optical pumping requires several watts of laser light which is supplied by multiple fiber-coupled laser diode arrays. Traditionally, each of these lasers required its own set of optics to collimate and circularly polarize the beam. This resulted in several beam lines with large angular offsets from the central beam line which limit the efficiency of optical pumping. We present a compact design using just one set of optics which takes advantage of a 5 to 1 fiber optic combiner. Upto 5 lasers can be connected to a combiner which ultimately results in just two nearly parallel beam lines. Another advantage is the easily adjustable size of the beam spot on the target. This design has already been successfully implemented in our lab and in the Jefferson Lab Hall A polarized $^3$He target. We also discuss an analysis of the design including a detailed optical pumping simulation used to motivate the design parameters.

Spinning targets use spin-exchange optical pumping (SEOP) are used for studying nucleon spin structure and neutron form factors, among other things. Optical pumping requires several sets of laser light which is supplied by multiple fiber-coupled laser diode arrays. Traditionally, each of these lasers required its own set of optics to collimate and circularly polarize the beam. This resulted in several beam lines with large angular offsets from the central beam line which limit the efficiency of optical pumping. We present a compact design using just one set of optics which takes advantage of a 5 to 1 fiber optic combiner. Up to 5 lasers can be connected to a combiner which ultimately results in just two nearly parallel beam lines. Another advantage is the easily adjustable size of the beam spot on the target. This design has already been successfully implemented in our lab and in the Jefferson Lab Hall A polarized $^3$He target. Previous SEOP targets in Hall A used a holding field supplied by a set of open Helmholtz coils. E02-013 used a magnetic box to provide a uniform magnetic field and to shield the target from the stray magnetic fields produced by the large acceptance open spectrometer placed close to the magnet. Several small polarimeter improvements were made. Innovations were also made to the measurements of the direction and homogeneity of the main holding field. These improvements will be discussed.

4:00PM EH.00011 TITAN Penning Trap mass spectrometer: design, commissioning and the near future, VLADIMIR RYIKOV, TRIUMF, MAXIME BRODEUR, JENS DILLING, TRIUMF/UBC, TITAN COLLABORATION — TITAN Penning Trap mass spectrometer is designed to use a variety of ion trapping techniques to conduct nuclear and atomic physics research. It will be used to study short-lived isotopes produced by the ISAC RIB source at TRIUMF National Laboratory in Vancouver, Canada. One of the components of the TITAN facility is the precision Penning trap mass spectrometer. It is now being commissioned and is scheduled for its first online mass measurement at the end of August of 2007. An overview of the TITAN Penning trap mass spectrometer design will be given. The preliminary results of the commissioning run will be described and the short-term measurement goals will be outlined.

References:

4:12PM EH.00012 Solid State Photomultipliers for Nuclear and High Energy Experiment Applications. ERIK JOHNSON, Radiation Monitoring Devices, Inc., SKIP AUGUSTINE, Augustine Engineering, RADIA SIA, CHRISTOPHER STAPELS, JAMES CHRISTIAN, Radiation Monitoring Devices, Inc. — Solid-State Photomultipliers (SSPMs) are an array of photodiodes built on a common substrate. Each photodiode is operated in a Geiger mode, where a single photon could trigger a self-sustained avalanche. The avalanche is quenched either using passive quenching or active quenching circuits (both methods will be discussed). The avalanche provides a gain of ~10^6, which is comparable to existing photomultiplier tubes. Radiation Monitoring Devices has built SSPMs with CMOS processes, which allows for integrating signal processing and photon collection on one chip, allowing for a detector-on-a-chip design. A number chip designs will be presented showing the potential of these devices for various applications for nuclear and high-energy experiments.

4:24PM EH.00013 Solid-State Photomultipliers Operated In Extreme Experimental Conditions. ERIK JOHNSON, Radiation Monitoring Devices, Inc., SKIP AUGUSTINE, Augustine Engineering, CHRISTOPHER STAPELS, RADIA SIA, JAMES CHRISTIAN, Radiation Monitoring Devices, Inc. — Nuclear and high-energy physics experiments that are conducted in harsh environments, such as in a liquid nitrogen bath, a high magnetic field of several Tesla, a small physical region of a few centimeters, a high intensity radiation field of hundreds of mrad/hour, require improved sensors that operate in these conditions. Advances in detector technology used in extreme environments can improve the data quality and allow new designs for experiments that operate under these conditions. Solid-State Photomultipliers (SSPM), a device built from an array of photodiodes, is a compact, high-gain photodetector with insensitivity to low temperatures, high radiation fields, and strong magnetic fields. Radiation Monitoring Devices has built SSPMs with CMOS processes, which allows for integrating signal processing and photon collection on one chip, allowing for a detector-on-a-chip design. SSPMs were exposed to 26 rads of dose from beams of 1 GeV/n silicon nuclei and 1 GeV protons, low temperature conditions from 77 K to 4 K, and high magnetic fields around 1 Tesla. The SSPMs were characterized under these extreme conditions.

Saturday, October 13, 2007 9:00AM - 11:24AM – Session HA AdS/CFT - Applications of String Theory to Nuclear Physics — City Center Grand Salon I

9:00AM HA.00001 Bulk Properties and Collective Flow of Quark Gluon Plasma, JOSEPH KAPUSTA, University of Minnesota — Quantum Chromodynamics predicts a transition from a hadronic phase at temperatures less than 150–200 MeV to a quark gluon plasma phase at higher temperatures. Lattice calculations show a big increase in the entropy density in this vicinity. Whether the transition is first or second order or a smooth rapid crossover depends upon the values of the up, down and strange quark masses. The goal of the heavy ion experimental program at RHIC is to observe this transition and to study the nature of the quark gluon plasma quantitatively. Two big surprises arose from these experiments: Substantial collective flow has been observed, as evidenced by single-particle transverse momentum distributions and by azimuthal correlations among the produced particles, and the degree to which high energy jets are attenuated in the produced matter. A variety of theoretical models of these collisions require initial energy densities more than a factor of 10 greater than in neutron star cores and more than a factor of 100 greater than within atomic nuclei. Taken together this body of work implies a strongly interacting phase of quarks and gluons beyond the capabilities of perturbation theory. This has motivated approaches based on gauge theories with gravity duals where physical observables may be calculated in a strong coupling limit. This in turn has stimulated interest from members of the string theory community who are currently bringing their expertise to bear on the problem.

9:36AM HA.00002 Quark Gluon Plasma: Experiments With Strings Attached, BARBARA JACAK, Stony Brook University — Experiments have shown that the hot partonic matter formed in heavy ion collisions at RHIC has substantial collective flow and is highly opaque to energetic quarks and gluons. New measurements of strange quark, energetic jets, and rare particles containing heavy quarks are beginning to shed light on properties of this novel plasma. Constraints on the viscosity per unit entropy, timescales for thermalization and build-up of collective motion, diffusion of heavy quarks, the response of the medium to deposited energy, and perhaps even the speed of sound in the plasma are now becoming experimentally accessible. The new data have inspired novel approaches to calculating the properties of quantum systems in the strong coupling limit.

10:12AM HA.00003 Understanding the Quark-gluon Plasma via String Theory, HONG LIU, Massachusetts Institute of Technology — Collisions of high-energy gold nuclei at the Relativistic Heavy Ion Collider (RHIC) in Brookhaven National Laboratory create exploding droplets of quark-gluon plasma, the stuff which filled the universe microseconds after the Big Bang. The quark-gluon plasma at RHIC exhibits many surprising properties: it is close to an ideal liquid and it strongly attenuates the high energy quarks trying to plow through it. So far calculations in QCD have not been able to explain these properties satisfactorily, but interesting insight has been gained by using techniques from string theory. In the last ten years string theory has revealed a surprising and deep connection between quantum gravity and non-Abelian gauge theories similar to QCD. Such a connection enables one to answer difficult questions in some strongly coupled gauge theories by simple calculations of classical gravity. I will discuss some examples where these string theory techniques have been used to shed light on existing data from RHIC and to make one prediction that can be tested by experiments in the near future.

10:48AM HA.00004 A few comparisons between string theory and heavy-ion physics, STEVEN GUBSER, Princeton University — String theory—in particular, the gauge-string duality—provides a window into the physics of strongly coupled gauge theories which may be of use in understanding aspects of relativistic heavy ion collisions. Although the supersymmetric gauge theories we understand most clearly via string theory are not QCD, their behavior at finite temperature seems to be similar enough to the deconfined quark-gluon plasma to make meaningful comparisons. Interesting comparisons include thermalization time, energy loss by heavy quarks, and the formation of softons. Momentum diffusion by heavy quarks raises some intriguing puzzles. The string theory comparisons all hinge on the dynamics of black horizons in a fifth dimension used to characterize energy scales. Although such horizons may seem fanciful, they in fact provide very practical and direct tools for computing dynamical properties of analogs of the quark-gluon plasma. The overall picture is that a few string theory predictions are suggestively close to experimentally favored values, but non-trivial barriers remain to making the predictions more precise.

Saturday, October 13, 2007 9:00AM - 11:36AM – Session HB Mini-Symposium on Dijets and Correlations in HI Collisions — City Center Grand Salon III
that a strongly interacting medium is formed in ultra-relativistic heavy ion collisions at RHIC. In particular, on the away side of a high \(\text{Au}\) associated jet-like hadron yield is strongly suppressed at high \(\sqrt{s}\) only at higher energies. Results for short and long-range multiplicity correlations (forward-backward) are presented for several systems (\(\text{Au+Au}\), \(\text{Cu+Cu}\), and \(\text{p+p}\)) in the rapidity region is dominated at all energies by short range correlations. Correlations that extend over a longer range are observed in hadron-hadron interactions among particles produced in different rapidity regions may provide an understanding of particle production mechanisms. Production of particles in the central \(\Lambda\) and \(\bar{\Lambda}\) models have been successful, is of particular interest. Studies of \(\Lambda\), \(\bar{\Lambda}\), \(K^0\), and \(\Xi^0\) production in jets using azimuthal and pseudorapidity correlations in \(\text{Cu+Cu}\) collisions at \(\sqrt{s_{NN}} = 200\text{GeV}\) are presented. The dependencies of the long range pseudorapidity correlations and near side jet-like correlations on particle type, transverse momentum, size, and centrality are presented and compared to analyses performed in \(\text{Au+Au}\) collisions at \(\sqrt{s_{NN}} = 200\text{GeV}\). These results help distinguish between particle production mechanisms.

9:48AM HB.00003 Decomposition of away-side components of dijet correlation in \(\text{Au+Au}\) collisions at \(\sqrt{s_{NN}} = 200\text{ GeV}\). CHIN-HAO CHEN, Stony Brook University, PHENIX COLLABORATION — A hot dense QCD matter is created by heavy ion collision in Relativistic Heavy Ion Collider (RHIC). Since parton fragments from high-\(p_T\) scattering form back-to-back hadron pairs, studying the dihadron or photon-hadron angular correlation can probe the medium response to energy deposited by the partons. At intermediate transverse momentum (\(p_T\)), modified away-side dijet correlation has been observed. Unlike \(\text{p+p}\) collisions, where the away side peaks at \(\Delta \phi = \pi\), there is a local minimum at \(\Delta \phi = \pi\) in \(\text{Au+Au}\). The modified shape suggests a medium response to energy deposited by the transiting parton. We present photon-hadron correlations from \(\sqrt{s_{NN}} = 200\text{ GeV}\) \(\text{Au+Au}\) collisions in the PHENIX run4 data set. We separate the jet components which “punch through” the medium from the side peak due to the medium response, counting the number of particles observed in each. These are studied as a function of collision centrality and compared with the \(\text{p+p}\) dijet correlation.

10:00AM HB.00004 Two-Particle Jet-Correlations from STAR: Systematics from Charged Hadrons and First Result for Net-Charges. QUAN WANG, Purdue University, STAR COLLABORATION — Two-particle jet-like correlations of charged hadrons with a high \(p_T\) trigger particle are strongly modified at RHIC, lending strong support for jet quenching and partonic energy loss. We present a systematic study of 2-particle jet-correlations in azimuth (\(\Delta \phi\)) and pseudo-rapidity (\(\Delta \eta\)) as a function of trigger and associated particle \(p_T\), system size, and collision centrality. In central heavy-ion collisions, significant excess of correlated particles are found on the away-side at about 1 radian away from \(\Delta \phi = \pi\), and those correlated particles are observed to possess a larger average (\(<p_T>\)) than those at \(\pi\). In order to investigate the physics mechanisms underlying these observations, azimuthal correlations of net-charges, reflecting mostly net-protons, are analyzed. First result from the analysis will be reported.

10:12AM HB.00005 System size dependence of di-hadron correlations yields and fragmentation functions at RHIC. OANA CATU, Yale University, STAR COLLABORATION — Di-hadron correlations have provided one of the first indications that a strongly interacting medium is formed in ultra-relativistic heavy ion collisions at RHIC. In particular, on the away side of a high \(p_T\) trigger hadron the associated jet-like hadron yield is strongly suppressed at high \(p_T\), which is interpreted as final-state parton energy loss. Taking the method one step further, we investigate the modification of the away-side di-hadron fragmentation functions for high transverse momentum particles in \(\text{Au-Au}\) and \(\text{Cu-Cu}\) collisions at \(\sqrt{s_{NN}} = 200\text{GeV}\) as measured in STAR. A comparison with theoretical predictions using NLO pQCD is also presented and allows the determination of the transport coefficient of the medium and therefore of the initial gluon density. The study of two systems with different geometries allows the testing of the path length dependence. We also present the near- and away-side yields as a function of number of participants, which could provide more information on the influence of the geometry on the observed triggered correlations.

10:24AM HB.00006 Energy and System-Size Dependence of Long-Range Multiplicity Correlations from the STAR Experiment. TERENCE TARNOWSKY, Purdue University, STAR COLLABORATION — The study of correlations among particles produced in different rapidity regions may provide an understanding of particle production mechanisms. Production of particles in the central rapidity region is dominated at all energies by short range correlations. Correlations that extend over a longer range are observed in hadron-hadron interactions only at higher energies. Results for short and long-range multiplicity correlations (forward-backward) are presented for several systems (\(\text{Au+Au}\), \(\text{Cu+Cu}\), and \(\text{p+p}\)) and energies (e.g. \(\sqrt{s_{NN}} = 200\) and 62.4 GeV). These correlations are measured with increasing values of a gap in pseudorapidity, from no gap at midrapidity to a separation of 1.6 units (+/-0.8). For the highest energy, central \(\text{A+A}\) collisions, the correlation strength maintains a constant value across the measurement region. In peripheral collisions, at lower energies, and in \(\text{p+p}\) data, the maximum appears at midrapidity. Comparison to models with short-range (HJING) and both short and long-range interactions (Parton String Model) do not fully reproduce central \(\text{Au+Au}\) data. String fusion as implemented in the Parton String Model is one possibility that has been explored to understand the behavior seen in the data. This result may indicate a reduction of number of particle sources for central \(\text{Au+Au}\) collisions at \(\sqrt{s_{NN}} = 200\text{ GeV}\) and the possible formation of high density matter.

10:36AM HB.00007 Jet Correlations after an event-selection of two back-to-back, high-\(p_T\) particles. CRAIG OGILVIE, Iowa State University, PHENIX COLLABORATION — High-momentum partons lose energy as they travel through the dense QGP that is formed at RHIC. The amount of energy-loss depends on both the density of the medium and the path-length that is traveled by the parton. How to best disentangle these two effects is an open question: work proceeds on multiple fronts: studying energy-loss versus reaction plane, centrality, and for different size colliding systems. Part of the difficulty is the strong energy-loss means that partons, which survive to produce high-\(p_T\) hadrons, come from hard-collisions that occur predominantly near the surface of the dense matter. One possible method to alter this surface-bias is to select events that have two back-to-back high-\(p_T\) hadrons. On average these partons will have traveled through similar lengths of dense matter and lost similar amounts of energy. This shifts the surface bias towards events that have two hadrons produced in the same event. Data from \(\text{A+A}\) collisions using this event selection will be compared with data from \(\text{p+p}\) collisions.
with \( \hat{\pi} \) for the nuclear modification factor. By selecting photons associated with jets on the near side using hadron-photon correlations, fragmentation photons can be observed. Recent examples for PHENIX have found an interesting two-component pt- dependence of these two-particle yields. Extending the 2- particle correlations result by requiring a third hard particle in certain phase space regions, may reveal more detailed information about energy loss and possible resulting geometric biases. Yet another example is moments of the momentum ratio distributions of the jet particles which may also be able to distinguish energy loss models. The status of such analyses in PHENIX and also their relation to Direct Photon-Jet correlations also explored by PHENIX will be discussed.

11:00AM HB.00009 Gamma-Jet Analysis in Heavy Ion Collisions with the STAR Detector, MARTIN CODRINGTON, Texas A&M University, STAR COLLABORATION — One of the most intriguing results from RHIC experiments thus far is the observed suppression of hadrons at high transverse momentum, which is attributed to final state medium-induced energy loss of hard scattered partons. To quantify the energy loss and the response of the medium to the deposited energy and momentum, a probe is needed that has negligible interaction with the medium itself, and thereby can provide a calibration of the momentum scale of the underlying process. One such probe is a prompt photon (i.e. produced from the initial hard scattering process). Such a photon should allow one to study the attenuation and modification of a jet with well-defined energy quantitatively and thus promises to provide a wealth of information about the energy-loss process. There is, however, a large background of photons from the decay of neutral mesons (mainly the \( \pi^0 \)). Ideally, a large fraction of these decay photons are rejected before a correlation study is undertaken. In the STAR experiment, this can be done using the transverse shower profile measured in the Shower Maximum Detector (SMD) of the Barrel Electromagnetic Calorimeter (BEMC). The latest results of this analysis will be presented.

11:12AM HB.0010 Direct measurement of fragmentation photons in p+p collisions at \( \sqrt{s_{NN}} = 200 \text{ GeV} \) with the PHENIX experiment, ALI HANKS, Columbia University, PHENIX COLLABORATION — Direct photon production is an important observable in heavy ion collisions, as photons are penetrating and therefore largely insensitive to final state effects that lead to jet quenching. Perturbative QCD calculations predict a contribution of up to 30\% to the direct photon yield from photons produced through parton fragmentation. In heavy ion collisions this contribution can be modified due to additional stimulated photon bremsstrahlung as well as the energy loss of the partons through gluon radiation prior to fragmentation. A measure of photon-bremsstrahlung would provide direct observation of the scattering of jets in the medium. Thus measurements of the fragmentation component to direct photons yield in both p+p and Au+Au collisions will provide both an important test of pQCD predictions and of predictions for the nuclear modification factor. By selecting photons associated with jets on the near side using hadron-photon correlations, fragmentation photons can be measured directly. However, most photons correlated with jets come from \( \pi^0 \)'s, \( \eta \)'s, and other hadronic decays and must be tagged and subtracted from the inclusive correlations. We present studies of this methodology and its application to recent p+p data at PHENIX.

11:24AM HB.00011 Analysis of two-particle jet correlations with a scaling formula, MICHAEL TANNENBAUM, Brookhaven National Laboratory — At DNP06, a new formula for the distribution of an associated away-side particle with transverse momentum \( p_T \), which is presumed to be a fragment of an away-jet with \( p_T \), triggered by a particle with transverse momentum \( p_T \), presumably from a trigger-side jet with \( p_T \), was given: 
\[
\frac{d^2p_T^a}{dx_E^\pm} = \frac{1}{x_E^\pm} \frac{d^2p_T}{dx_T^\pm}
\]
where \( x_E^\pm \approx p_T^a/p_T \) is the ratio of the transverse momenta of the particles, \( x_T^\pm \) is the multiplicity of particles in the away jet. Many analyses of the away-jet \( p_T \) distributions in Au+Au collisions are available; but these tend to describe the effect of the medium with the variable \( f_{AA}(x_E) \), the ratio of the \( x_E \) distribution in \( A+A \) collisions to that in p-p collisions, which typically shows an enhancement at low values of \( x_E \) and a suppression at higher values of \( x_E \). Such behavior could be explained as a decrease in \( x_T \) in A+A collisions due to energy loss of the away jet in the medium. Fits of the above formula to the available data will be presented to establish whether: a) the away-jets simply lose energy; b) some of the away-jets lose energy, others punch-through without losing energy; etc.

Supported by the U.S. Department of Energy, Contract No. DE-AC02-98CH1-886.

Saturday, October 13, 2007 9:00AM - 12:00PM —
Session HC Electromagnetic Interactions II Newport News Marriott at City Center Pearl Salon I

9:00AM HC.00001 Scaling study of the pion electroproduction cross sections and the pion form factor, TANJA HORN, Jefferson Lab, PIONCT COLLABORATION — One of the main objectives of Jefferson Lab is to understand the structure of the nucleon in terms of the quark-gluon degrees of freedom. Measurements of inclusive processes, such as deep inelastic scattering (DIS), have shown that in the limit of large \( Q^2 \), at fixed values of \( x_B \), such processes can be viewed as scattering from individual partons within the hadronic system. A similar factorization of scales, allowing perturbative QCD concepts to be used in the description of hadrons, may be expected in hard exclusive processes. The \( Q^2 \) dependence of the separated \( p(e,e'\gamma N) \) in cross sections provides one of the best ways to test the factorization of long-distance from short-distance physics, and at which values of \( Q^2 \) it applies. Such tests will lay the foundation for a reliable interpretation of the results from the GPD program at Jefferson Lab, and for GPD studies with a future electron-ion collider. In this talk I will present a QCD scaling study using published \( ^1H(e,e'\gamma N) \) in cross sections and new results from the eCT experiment (E01-107), which was carried out in Hall C at Jefferson Lab.

9:12AM HC.00002 Truncated Moment Analysis of Nucleon Structure Functions, ALES PSAKER, apsaker@physics.edu, ERIC CHRISTY, CYNTHIA KEPPEL, Hampton University, WALLY MELNITCHOUK, Jefferson Lab — The understanding of quark-hadron duality in nucleon structure functions (namely, the similarity between the scaling and resonance averaged functions) within QCD is currently incomplete. While moments of structure functions can be analyzed within the operator product expansion in terms of leading and higher twist contributions, the description of duality as a function of Bjorken \( x \) requires phenomenological models. We employ a novel new approach using “truncated” moments, or integrals of structure functions over restricted regions of \( x \), to study the degree to which individual resonance regions are dominated by leading twists. Because truncated moments obey the same \( Q^2 \) evolution equations as the leading twist parton distributions, our approach makes possible for the first time a description of resonance region data and the phenomenon of quark-hadron duality directly from pQCD.

9:24AM HC.00003 Hard Photo-disintegration of proton pairs in \(^3\text{He}\), RONALD GILMAN, Rutgers University, ELI PIASETZKY, ISHAY POMERantz, Tel Aviv University, FOR THE JEFFERSON LAB HALL A COLLABORATION — Hard deuteron photo-disintegration has been investigated for 20 years, as its cross sections follow the constituent counting rules and it provides insight into the interplay between hadronic and quark-gluon degrees of freedom in high-momentum transfer exclusive reactions. We have now measured for the first time hard pp-pair disintegration in the reaction \( ^3\text{He} \rightarrow pp+n \), using kinematics corresponding to a spectator neutron. 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., the \( a_n \) distribution, and the angular distribution.

3Supported by the Israel Science Foundation and the U.S. National Science Foundation Grant PHY 03-54871.
9:36AM HC.00004 Quark-Hadron Duality on the Neutron (³He) Spin Structure. 

PATRICIA SOLVIGNON, Argonne National Laboratory, THE JEFFERSON LAB HALL A COLLABORATION — In 1970, Bloom and Gilman made a surprising observation that the spin-independent structure function $F_2$ measured in the resonance region averages on the curve determined by the deep inelastic scattering data when a proper scaling variable is used. This phenomenon is called quark-hadron duality and links the non-perturbative and perturbative regimes of QCD. Recently, quark-hadron duality has been quantitatively established for the spin-independent structure function $F_2$ of the proton in Jefferson Lab Hall C. New results are also coming out for the spin structure function $g_1$ on the proton and the deuteron from Halls B and C. Jefferson Lab Hall A experiment E01-012 used the polarized $^3$He target for a measurement of the spin structure function $g_1^{^3\text{He}}$ and the virtual photon asymmetry $A_1^{^3\text{He}}$ in the resonance region over a $Q^2$ range from 1.0 to 4.0 (GeV/c)^2. Data from E01-012 compared with deep inelastic scattering data will provide a test of quark-hadron duality for the spin structure functions of the neutron. This will be one of the first tests of the spin and flavor dependence of quark-hadron duality. The demonstration of duality for spin structure functions will help to study the transition from partonic to hadronic degrees of freedom and to quantify the size of higher twist effects. Details of the experiment and final results will be presented.

9:48AM HC.00005 Measuring the Neutron and $^3$He Spin Structure at Low $Q^2$. VINCENT SULKOSKY, Jefferson Lab, JEFFERSON LAB HALL A COLLABORATION — The study of the nucleon spin structure has been an active field for the past few decades. The ultimate goal is to understand the structure and interactions of protons and neutrons in terms of quarks and gluons. The Gerasimov-Drell-Hearn (GDH) sum rule is an important tool available to study nucleon spin structure. Originally derived for real photon absorption, the sum rule was first extended to non-zero $Q^2$ in 1989. The extension of the sum rule provides a $Q^2$-dependent relation that can be used to study the nucleon spin structure and make comparisons between theoretical predictions and the experimental data. Jefferson Lab experiment E97-110 performed a precise measurement of the $Q^2$ dependence of the extended GDH integral and of other moments of the neutron and $^3$He spin structure functions between 0.02 and 0.3 GeV^2. These data allow us to test chiral perturbation theory calculations and check the GDH sum rule by extrapolating to the real photon point. The data were taken in Hall A using the Jefferson Lab polarized continuous electron beam and a polarized $^3$He target. The experimental details will be discussed, and preliminary results will be presented.

10:00AM HC.00006 Inclusive Scattering from Nuclei at $x > 1$ and high $Q^2$ with a 6 GeV beam. NADIA FOMIN, University of Virginia — Inclusive electron scattering from nuclei at large $x$ and $Q^2$ is the result of a reaction mechanism that includes both quasi-elastic scattering from nucleons and deep inelastic scattering from the quark constituents of the nucleons. Consequently, it provides an opportunity to investigate the transition from the regime where nucleon degrees of freedom dominate to one where the more fundamental QCD interactions are exposed. Data in this regime can be used to study a wide variety of topics, including the extraction of nuclear momentum distributions, the influence of final state interactions and the approaches to describing the strength of nuclear structure correlations, and the approach to $x$-scaling, to name a few. We recently performed an experiment in Jefferson Lab’s Hall C using a 6 GeV beam and a range of both light and heavy nuclei which was designed to significantly extend the kinematic region at high momentum transfer and large (negative) $y$, previously explored in SLAC experiment NE3 and Jefferson Lab experiment E89-008. After a brief statement of the physics goals of this experiment, we will present results and discuss possible interpretations.

10:12AM HC.00007 A Precision Measurement of the Neutral Pion Lifetime Via the Primakoff Effect. ERIC CLINTON, University of Massachusetts Amherst, PRIMEX COLLABORATION — The neutral pion lifetime is arguably the most precise theoretical calculation possible in low energy QCD, but the current world data are not commensurate with theory. Recent calculations predict a neutral pion radiative width of 8.1 eV ± 1%, while the PDG average stands at 7.84 eV ± 7%. The Primakoff Experiment (PrimEx) collaboration has utilized the Primakoff effect, photo-meson production in the Coulomb field of nuclei, to generate neutral pions. PrimEx collected data in Hall B at the Thomas Jefferson National Accelerator Facility with the expectation of measuring the neutral pion lifetime to an accuracy of 1.5%. Results of this measurement will be presented. This result is a stringent test of the U(1) axial anomaly, and thus fills an important gap in our knowledge of low energy QCD.

10:24AM HC.00008 Semi-Inclusive, Single Pion Electro-production from a Deuteron Target. NARBE KALANTARIANS, University of Houston, BONUS COLLABORATION — Relative to the case for the proton, very little is known of Semi-Inclusive Deep Inelastic Scattering (SIDIS) physics resulting from a deuteron target. Electrons with energy of 5.3 GeV are used on both deuteron and proton targets to study single pion production in the SIDIS framework for all 3 pion charge states. What makes this specific experiment unique is that it offers a virtually $Q^2$-scaling, the strength of nucleon-nucleon correlations, and the approach to $x$-scaling, to name a few. We recently performed an experiment in Jefferson Lab’s Hall C using a 6 GeV beam and a range of both light and heavy nuclei which was designed to significantly extend the kinematic region at high momentum transfer and large (negative) $y$, previously explored in SLAC experiment NE3 and Jefferson Lab experiment E89-008. After a brief statement of the physics goals of this experiment, we will present results and discuss possible interpretations.

10:36AM HC.00009 Barely Off-Shell Nucleon Structure. NATHAN BAILLIE, The College of William and Mary, CLAS COLLABORATION — The Barely Off-Shell Nucleon Structure (BoNuS) experiment measured electron scattering from neutrons bound in deuterium nuclei at Jefferson Lab’s Hall B with the intent of obtaining the ratio $F_2 / F_I$ at high Bjorken $x$. The $F_I$ structure function is difficult to obtain due to nature’s lack of a free neutron target. Previous experiments have measured inclusive quasi-elastic scattering in atomic nuclei, corrected for scattering from the protons in the nucleus, and relied upon models for the neutron binding and motion to obtain $F_I$. In BoNuS we restrict our analysis to neutron scattering events tagged by a backward-going low-energy recoil proton. This selects loosely bound neutrons that are nearly on their mass-shell and have few final-state interactions with the recoil proton. The recoil protons were detected in a Radial Time Projection Chamber (RTPC) using gas electron multipliers (GEMs) in a cylindrical geometry around the target. We will present the first preliminary results for $F_2 / F_I$ in the resonance and deep-inelastic regions.

1 This work was partially supported by DOE Contract No. DE-AC05-84ER40150 under which the Southeastern Universities Research Association (SURA) operates the Thomas Jefferson National Accelerator Facility (Jefferson Lab).

10:48AM HC.00010 A Measurement of the Electron Compton Scattering Cross Section in the Jefferson Lab PrimEx Experiment. YELENA PROK, PRIMEX COLLABORATION — The PrimEx experiment at Jefferson Lab has been designed to perform a high precision (≈ 1.5 %) measurement of the neutral pion lifetime using the small angle coherent photoproduction of $\pi^0$s in the Coulomb field of a nucleus, i.e., the Primakoff effect. This measurement is a rigorous test of axial anomaly, which is a fundamental prediction of low energy QCD. In view of the required precision for this experiment, periodic measurements of the well known cross section in Compton scattering off atomic electrons were performed. The data were collected in Hall B of Jefferson Lab, using a high resolution hybrid calorimeter (HyCal), photon tagger, and carbon and beryllium targets. Analysis techniques and preliminary results will be presented in this talk.
The past and future in the field of Nuclear Astrophysics at ISAC will be discussed. The prospects of addressing the nuclear physics problems with radioactive beam experiments. This has greatly increased the need for reliable nuclear physics to enable astrophysical r- and rp-processes leave important signatures in the cosmic pattern of elemental abundances and in the observed features of astrophysical events. A wealth of new observational data has been collected on these signatures over the last years, providing new clues and also puzzles related to some key questions in nuclear astrophysics. This work was supported in part by the U.S. Department of Energy, Office of Nuclear Physics, under Contract No. DE-AC02-06CH11357 and by the NSF Grant No. PHY-02-16783 (Joint Institute for Nuclear Astrophysics).

The past and future in the field of Nuclear Astrophysics at ISAC will be discussed. The prospects of addressing the nuclear physics problems with radioactive beam experiments. This has greatly increased the need for reliable nuclear physics to enable astrophysical r- and rp-processes leave important signatures in the cosmic pattern of elemental abundances and in the observed features of astrophysical events. A wealth of new observational data has been collected on these signatures over the last years, providing new clues and also puzzles related to some key questions in nuclear astrophysics. This work was supported in part by the U.S. Department of Energy, Office of Nuclear Physics, under Contract No. DE-AC02-06CH11357 and by the NSF Grant No. PHY-02-16783 (Joint Institute for Nuclear Astrophysics).
10:00AM HD.00004 Laboratory Measurements of Explosive Nucleosynthesis1, P.D. PARKER, J.A. CAGGIANO, J.A. CLARK, C.M. DEIBEL, R. LEWIS, A. PARIKH, C. WREDE, Yale University — The determination of reaction rates involving radioactive nuclei is essential for understanding explosive nucleosynthesis. This can involve direct studies using radioactive beams (e.g., 13N, 17F, 21Na, etc.) and/or indirect studies of the properties of residual systems and their particle decays (e.g., 19Ne*→18F+p, 27Si*→26Al+p, 31S*→30P+p, etc.). Examples of these types of studies and their complementarity will be discussed.

1Supported by USDOE under grant DE-FG02-91ER40069.

10:12AM HD.00005 The impact of the 26Al(p,γ)27Si reaction rate on the destruction of 26Al in ONe novae1, CATHHERINE DEIBEL, Yale University, JAC CAGGIANO, PNL, JASON CLARK, Yale University, RACHELLE LEWIS, University of York, ANUJ PARIKH, PETER PARKER, CHRISTOPHER WREDE, Yale University — Evidence of ongoing nucleosynthesis of 26Al (τ1/2 = 7.2 × 10^7 yr) in our galaxy has been observed in the form of the 1.809 MeV γ-ray resulting from 25Mg(p,γ)26Al(γ)+((β+)γ)26Mg* [1]. The 25Mg(p,γ) reaction can also produce 26Al^m, the short lived (τ1/2 = 6.3 s), 0+, isomeric state of 26Al, which β+-decays to 26Mg^2-; only and must be treated separately from 26Al(γ) at peak temperatures typical in novae (T_0 ≈ 0.1 - 0.35) [2]. Since 26Al(p,γ)27Si competes with the β+-decay of 26Al in novae, resonances in 26Al(γ) and 27Si may have a significant impact on 26Al production. We have used the 26S(p,d)27Si, 26Si(^3He,α)27Si(^3He,γ)27Si(p)26Al, and 27Al(^3He,t)27Si(^3He,γ)27Si reaction studies to calculate the 26Al(p,γ)27Si reaction. Several previously unpublished levels in 27Si and proton decay branching ratios will be reported. Their impact on the 26Al(p,γ)27Si reaction rate and the nucleosynthesis of 26Al in ONe novae will be discussed.


10:24AM HD.00006 Searching for resonances in the unbound 6Be nucleus1, K.Y. CHAE, U. OF TN, ORNL, D.W. BARDAYAN, J.C. BLACKMON, ORNL, A.E. CHAMPAGNE, U. OF NC, J.J. DAS, UIAC, India, R.P. FITZGERALD, ORNL, U. OF NC, V. GUIMARAES, U. OF Sao Paulo, K.L. JONES, Rutgers, M.S. JOHNSON, ORAU, R.L. KOZUB, TTN, R.J. LIVESAY, CO School of Mines, Z. MA, C.D. NESARAJA, U. OF TN, ORNL, S.D. PAIN, Rutgers, M.S. SMITH, ORNL, J.S. THOMAS, Rutgers, D.W. VISSER, U. OF NC — Knowledge of the 6Be nucleus is essential for understanding stellar burning and solar neutrino production. Previous measurements have found a surprisingly large rise in the cross section at low energies that could be due to a low energy resonance in the 6Be+4He system or electron screening. In the 6Be nucleus, however, no excited states have been observed above the first 2+ state at E_x = 1.67 MeV up to 23 MeV, even though several are expected. The (d,Be)10 reaction has been studied for the first time to search for resonances in the 6Be nucleus using radioactive 10Be beam at the ORNL Hofield Radioactive Ion Beam Facility. Details of the experiment and a report of the current stage of the analysis will be presented.

1Supported by USDOE under grant DE-FG02-91ER40069.

10:36AM HD.00007 Structure of 8Be through 8Be+p scattering1, J.C. BLACKMON, ORNL & LSU, R.J. LIVESAY, U. GREIFE, Colorado Sch. of Mines, D.W. BARDAYAN, K.Y. CHAE, ORNL, A.E. CHAMPAGNE, UNC-CH, C. DIEBEL, Yale Univ., R. FITZGERALD, UNC-CH & NIST, M.S. JOHNSON, ORAU & LLNL, K.L. JONES, Rutgers Univ. & Univ. Tenn., R.L. KOZUB, Tenn. Tech. Univ., Z. MA, C.D. NESARAJA, ORNL, S.D. PAIN, Rutgers Univ., F. SARAZIN, Colorado Sch. of Mines, J.F. SHRINER, JR., Tenn. Tech. Univ., D.W. STRACENER, M.S. SMITH, ORNL, J.S. THOMAS, Rutgers Univ. & Univ. Tenn., D.W. VISSER, UNC-CH, C. WREDE, Yale Univ. — Cross sections for 8Be+p elastic and inelastic scattering were measured at the HRIBF. Beams of 8Be at 17 incident energies between E_0 = 0.5-3.4 MeV bombarded CH2 targets. Scattered protons were detected in a silicon-strip detector array covering θ < 150°. We have performed a multi-level R-matrix analysis of the combined cross sections (about 400 data points) to determine properties of states in 8Be. The inelastic scattering data provide evidence for positive-parity states that were previously unobserved but were predicted by theory. Results and implications will be discussed.

1Supported by UT-Battelle, LLC, for the U.S. DOE under Contract No. DE-AC05-00OR22725.

10:48AM HD.00008 The 16N β-delayed α decay : Today and Tomorrow , XIAODONG TANG, University of Notre Dame — The 12C(α,γ)16O is one of the most important reactions in nuclear astrophysics. The best determination of the S factor relies on three different experiments, the elastic scattering of α off 12C, the α capture reaction on 12C and the 16N β delayed α decay. In this talk, I will review the current status of the existing 16N decay experiments. I will also discuss the possible 16N experiments in the near future to achieve more accurate S factor.

11:00AM HD.00009 Reaction Rates for Neutron Capture Reactions on Light sd-shell Nuclei . MARY BARRY, MICHAEL WIESCHER, University of Notre Dame, ALBERTO MENGONI, IAEA, B. ALEX BROWN, Michigan State University — Reaction rates of neutron capture cross sections on light nuclei are of great importance to a wide variety of astrophysical nucleosynthesis scenarios. Where experimental data is not available, theoretical estimates of these rates provide a vital basis for inputs into a spectrum of stellar scenarios. Neutron capture reaction rates have been calculated for a range of light sd-shell nuclei, stretching into the neutron rich. The context for the reaction rate calculation has been a hybrid model of compound and direct capture model, where necessary nuclear data, when absent from the literature, has been provided by theoretical shell model calculations.

11:12AM HD.00010 Single particle states in 131Sn and the r-process . R.L. KOZUB, J.F. SHRINER, JR., TTN, A. ADEKOLA, Ohio U., D.W. BARDAYAN, J.C. BLACKMON, F. LIANG, C.D. NESARAJA, D. SHAPIRA, M.S. SMITH, ORNL, K.Y. CHAE, K.L. JONES, Z. MA, B.H. MOAZEN, Uttk, K. CHIPPINS, L. ERIKSSON, CSM, J.A. CIZEWSKI, R. HATARIK, S.D. PAIN, Rutgers, C. MATEI, ORAU, W. KROLAS, IFI PAN, T.P. SWAN, Surrey/Reutgers — Recent r-process calculations suggest the 131Sn(n,γ)132Sn reaction rate plays a pivotal role in nucleosynthesis, engendering global effects on isotopic abundances over a wide mass range. 1 Direct neutron capture is likely the dominant reaction in the r-process near the N~82 closed shell, and the reaction rate is thus strongly impacted by the properties of single particle states in this region. We have acquired (dp) reaction data in the A~132 region in inverse kinematics using ~630 MeV beams (4.85 MeV/u) for 130Sn and Cd2 targets. An array of Si strip detectors, including SIDAR and an early implementation of the new ORRUBA, was used to detect reaction products. Preliminary excitation energies and angular distributions have been extracted for the strongest states observed in 131Sn, and DWBA calculations have been performed to determine ɛ-values. A status report on analysis and results will be presented.

2Research supported by the U. S. Dept. of Energy, the National Science Foundation, and the LDRD program at ORNL.
11:24AM HD.00011 TOF Mass Measurements of Very Exotic Nuclides: an Input for Astrophysical Calculations, M. MATOŠ, A. ESTRADA, M. AMTHOR, D. BAZIN, A. BECERIL, T. ELLIOT, D. GALAVIZ, A. GADE, G. LORUSSO, F. MONTES, J. PEREIRA, M. PORTILLO, A.M. ROGERS, H. SCHATZ, A. STOLZ, MSU, A. APRAHAMIAN, Notre Dame, D. SHAPIRA, ORNL, E. SMITH, OSU, S. GUPTA, M. WALLACE, LANL — Atomic masses play a crucial role in many nuclear astrophysics calculations. Very exotic nuclei can be accessed by time-of-flight techniques at radioactive beam facilities. The NSCL facility provides a well-suitied infrastructure for TOF mass measurements of very exotic nuclei. At this facility, we have recently implemented a TOF-Bν technique and performed mass measurements of neutron-rich nuclides in the Fe region, important for calculations of the r-process and processes occurring in the crust of accreting neutron stars. Description of the TOF technique, results and future plans related to nuclear astrophysics will be presented.

11:36AM HD.00012 NERO-The Neutron Emission Ratio Observer, G. LORUSSO, MSU, NSCL, JINA, JORQUE PEREIRA, NSCL, JINA, PAUL HOSSER, MSU, NSCL, JINA, KARL LUDVIG KRATZ, Institute fur kernchemie, Universitaet Mainz, FERNANDO MONTES, NSCL, PAUL REEDER, Pacific Northwest National Laboratory, PETER SANTI, NSCL, HENDRIK SCHATZ, NSCL, JINA — The Neutron Emission Ratio Observer (NERO), has been constructed for the use at the National Superconducting Cyclotron Laboratory to work in conjunction with the NSCL Beta Counting System in order to detect β-delayed neutrons. The design of the detector provides high and flat efficiency for a wide range of neutron energies, as well as a low neutron background.

Saturday, October 13, 2007 9:00AM - 11:12AM – Session HF Electroweak Interactions Newport News Marriott at City Center Pearl Salon II

9:00AM HF.00001 Beta-Neutrino Correlation in Laser-Trapped $^{21}$Na$^+$. P.A. VETTER, Lawrence Berkeley National Laboratory, J. ABO-SHAER, B.K. FUJIKAWA, Lawrence Berkeley National Laboratory, S.J. FREEDMAN, R. MARUYAMA, UC Berkeley Dept. of Physics/Lawrence Berkeley National Laboratory — We have re-measured the $\beta$-branching ratio in $^{21}$Na in a magneto-optic trap. We measure the momentum spectrum of the recoil nuclei by time-of-flight, using low-energy electrons shaken off by the recoil as a start signal. This scheme is a factor of 25 more efficient than our previous experiment (N.D. Scielzo et al., PRL 93, 102501 (2004)). We also detect autoionized Na$_2^+$, formed via photoassociation in our MOT. We believe that our previous measurement was erroneous because of contributions to the data from beta decays occurring in molecular Na. We have characterized the molecular formation rate as a function of trap population, and detected autoionized $^{21}$Na$^+$. We have acquired data using much smaller trapped samples, for which the molecular fraction of the decay events is an order of magnitude smaller, and we have taken data using a dark MOT, in which molecule formation is suppressed by three orders of magnitude. Our new result is inconsistent with our previous measurement, agrees with the calculated value of $\beta_{\beta-v} = 0.55(4)$, with absolute uncertainty about 0.006.

1This work was supported by the Director, Office of Science, of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

9:12AM HF.00002 Precision measurement of $^{23}$Al beta-decay $^{21}$Na$^+$. YONGJUN ZHAI, V.E. IACOB, J.C. HARDY, T. AL-ABDULLAH, A. BANU, C. FU, V.V. GOLOVKO, M. MCCLESKEY, N. NICA, H.I. PARK, G. TABACARU, R.E. TRIBBLE, L. TRACHE, Cyclotron Institute, Texas A&M University — The beta-decay of $^{23}$Al (see [1]) was re-measured with higher statistics and better accuracy at Texas A&M University. Using MARS we produced and separated pure $^{23}$Al at 4000 pps, with a 48 MeV/u $^{24}$Mg beam via the $^{23}$Mg($p$, 2$n$)$^{23}$Al reaction on a H$_2$ cryogenic target. New $\beta$ and $\beta - \gamma$ coincidence measurements were made with a scintillator, an HPGe detector with BGO shielding and the fast tape transport system. The BGO Compton shield very much improved the quality of the $\gamma$ spectra around the transition from the IAS state at 7803 keV. From the measured $\beta$ singles and $\beta - \gamma$ coincidence decay spectra we obtained an improved $\beta$-decay scheme and a more precise lifetime: $t=447(4)$ ms. We use the method of detailed balance to obtain absolute $\beta$-branching ratios and absolute log ft values for transitions to final states in $^{23}$Mg. For this method, precise efficiency calibration of the HPGe detector up to about 8 MeV is needed. We extended our previous efficiency calibration to the range $E_\gamma=3.5-8$ MeV using the $\beta$-decay of $^{21}$Al.


1Supported by DOE and the Robert A. Welsh Foundation.

9:24AM HF.00003 Confirmation of Precise Branching Ratio Measurement in the $\beta$ Decay of $^{34}$Ar. V.E. IACOB, J.C. HARDY, V. GOLOVKO, Cyclotron Institute at Texas A&M University — Precise $f$-values for superallowed 0$^+ \to 0^+$ $\beta^+-$decays yield a demanding test of the Standard Model via the unitarity of the Cabibbo-Kobayashi-Maskawa matrix. One of the ingredients of this $f$-value is the transition branching ratio which, to be relevant for the unitarity test, must be measured with a precision of $\sim 0.1\%$ or better. After a preliminary report of such a measurement for $^{34}$Ar [1], we have verified our methods and tested for any possible systematic effects by measuring the decay of $^{10}$C under similar conditions. This nucleus is very well suited for a test of the data reduction method: it has a simple decay scheme without a ground-state branch, and all decay branches generate a 718 keV gamma ray. As with the $^{34}$Ar measurement, an implanted $^{13}$C source was placed between a plastic scintillator for $\beta$ particles and a HPGe detector that is efficiency calibrated with high precision (0.2% between 50 and 1400 keV). Both $\beta$ singles and $\beta - \gamma$ coincidences were then recorded, and the collect/move/detected cycle was repeated until the desired statistical accuracy was obtained. We determined experimentally that the percentage of $^{10}$C decays leading to a 718 keV gamma ray is statistically consistent with the expected 100%. This result validates our methods and reinforces the branching-ratio value previously obtained for the $^{34}$Ar decay. [1] V. Iacob et al., Bulletin APS 52, (37) Apr-Meeting 2007

9:36AM HF.00004 The Search for a Non-Superallowed Branch in the $\beta$ decay of $^{38}$mK. KYLE LEACH, University of Guelph, D. BANDYOPADHYAY, P. FINLAY, P.E. GARRETT, G.F. GRINER, A.A. PHILLIPS, M.A. SCHMAK, C.E. SVENSSON, J. WONG, University of Guelph, Canada, G.C. BALL, E. BASSIACHVILLI, S. ETTENAUER, G. HACKMAN, A.C. MORTON, S. MYTHILI, O. NEWMAN, C.J. PEARSON, M.R. PEARSON, H. SAVAJOLS, TRIUMF, Vancouver, Canada, J.R. LESLIE, Queens University, Canada, D. MELCONIAN, University of Washington, Seattle, R.A.E. AUSTIN, St. Mary's University, Canada, C. BARTON, University of York, United Kingdom — The study presented is part of an experimental program exploring the properties of superallowed Fermi $\beta$ decays conducted at the Isotope Separator and Accelerator (ISAC) facility at TRIUMF in Vancouver, B.C. Canada. Using the $^{18}$O g-ray spectrometer and the Scintillating Electron Positron Tagging Array (SCEPTAR), it was possible to set a new upper limit on an unobserved non-analogue branch in the decay of $^{38}$mK. This branch is expected to be extremely weak, and the removal of contaminant isobaric decays and background radiation in the spectra was thus exceedingly important during the analysis. Our work has reduced the previous upper limit by approximately a factor of two and is approaching the theoretically predicted branching ratio.

1Work supported by the Natural Sciences and Engineering Research Council of Canada and the National Research Council of Canada.
9:48AM HF.00005 Isospin mixing in the nucleon and $^4\text{He}$ and the nucleon strange electric form factor, MICHELE VIVIANI, INFN, Sezione di Pisa (Italy), ROCCO SCHIAVILLA, ODU & Jefferson Lab. — In order to isolate the contribution of the nucleon strange electric form factor to the parity-violating asymmetry measured in $^4\text{He}(e,e')^4\text{He}$ experiments, it is crucial to have a reliable estimate of the magnitude of isospin-symmetry-breaking (ISB) corrections in both the nucleon and $^4\text{He}$. Isospin admixtures in the nucleon are studied by B. Kubis and R. Levis in Ref. Phys. Rev. C 74, 015204 (2006) in chiralturbation theory. We examine in the present contribution the issue of isospin admixtures in $^4\text{He}$ derived from ISB components in the nuclear and electromagnetic interactions. A careful analysis of the model dependence in the resulting predictions for the nucleon and nuclear ISB contributions to the asymmetry is carried out. We conclude that, at low momentum transfers of interest in recent measurements reported by the HAPPEX collaboration at Jefferson Lab, these contributions are of comparable magnitude to those associated with strangeness components in the nucleon electric form factor.

10:00AM HF.00006 Transverse Beam Spin Asymmetries in Backward-Angle Elastic Electron-Proton and Quasielastic Electron-Deuteron Scattering, JULIETTE MAMMELI, Virginia Tech, G0 COLLABORATION — There has been considerable recent interest in the two-photon exchange contribution to electron scattering, largely driven by the role the real part of this amplitude plays in the discrepancy between the Rosenbluth and polarization transfer measurements of the elastic form factor ratio $C_2^q/C_1^q$. The transverse beam spin asymmetry measured in the elastic scattering of electrons from unpolarized nucleons provides a measurement of the imaging part of the two-photon exchange amplitude. The $G^p$ collaboration at Jefferson Lab has taken data of this type during its backward-angle phase with an average laboratory electron scattering angle of 110°. Beam-normal single-spin asymmetry data were obtained under these conditions: elastic $e^+p$ at beam energies of 362 MeV ($Q^2 = 0.23\text{GeV}^2$) and 687 MeV ($Q^2 = 0.64\text{GeV}^2$) and quasi-elastic $e^+d$ at a beam energy of 362 MeV ($Q^2 = 0.23\text{GeV}^2$). The status of the analysis for these sets of data will be presented.

10:12AM HF.00007 A first measurement of neutrino nucleon elastic scattering in MiniBooNE, D. CHRISTOPHER COX, Indiana University, MINIBOONE COLLABORATION — Neutrino nucleon elastic scattering $\nu N \to \nu N$ is a fundamental process of the weak interaction, and provides insight into the structure of the nucleon. In MiniBooNE, a neutrino oscillation experiment at Fermilab, this process comprises about 15% of all neutrino interactions, making it MiniBooNE’s third largest scattering process with over two hundred thousand events expected in the current data sample. First cross section results will be presented.

10:24AM HF.00008 SciBooNE experiment, the neutrino cross section measurement, TEPPEI KATORI, Indiana University, SCIBOONE COLLABORATION — The SciBooNE experiment will measure muon neutrino and antineutrino cross sections on carbon near 1 GeV with unprecedented precision. SciBooNE uses the Booster Neutrino Beam at Fermilab and the SciBar vertex detector formerly used in the K2K experiment at KEK. SciBooNE started its data run in antineutrino mode in June, 2007. Physics potential of the experiment and first data will be shown.

10:36AM HF.00009 Neutrino Interactions in the MINOS Near Detector, MICHAEL KORDOSKY, University College London, MINOS COLLABORATION — The Main Injector Neutrino Oscillation Search (MINOS) is a long baseline neutrino oscillation experiment that uses a muon-neutrino beam produced by the Neutrinos at the Main Injector (NuMI) facility at Fermi National Accelerator Laboratory (FNAL). The experiment is conducted with a pair of functionally identical detectors, located at two sites, the Near Detector at FNAL and the Far Detector in the Soudan Underground Laboratory in Minnesota. The high intensity NuMI beam provides a large neutrino event sample in the Near Detector which can be used to characterise neutrino-nucleus interactions. I will describe the experimental procedure for deducing the neutrino flux and follow with prospects for measuring the energy dependence of the inclusive muon neutrino and anti-neutrino charged-current cross-section. I will close with a discussion of the experiment’s ability to measure the $Q^2$ dependence of the quasi-elastic scattering cross-section as well as the structure functions $F_2$ and $x F_3$ at low $Q^2$ and high $x$.

10:48AM HF.00010 Lorentz and CPT violation test in BNL muon g-2 data, XIAOBO HUANG, Boston University, BNL MUON G-2 COLLABORATION — V.A. Kostelecky et. al. proposed an extension of the standard model of the particle physics which allows Lorentz and CPT violation by introducing additional terms to the Lagrangian of the standard model. In this extended standard model, the muon anomalous precession frequency, $\omega_a$, is evaluated. There are two Lorentz and CPT violation signatures predicted: nonzero $\Delta \omega_a = [(\omega_a^\mu - \omega_a^e) / 2]$ and sidereal variation of $\omega_a^\mu$. A Lorentz and CPT invariance test, using the BNL muon g-2 data, is done. No significant effect was found. The limit of Lorentz and CPT violation is set to be at the level of $10^{-24}$ GeV.

11:00AM HF.00011 Everything from nearly ‘Nothing’ A Topologically Substructured Spindominated Superstring Concept and its Universal Physical and Cosmological Implications, PAUL W. BUECKING — The present concept of a string is too simple. It does not have the necessary level of complexity needed to express the ‘Everything’. On string level no defined unique structure exists that inherently can make the world the way it is in a self-consistent way. The idea of a vacuum deflates string theory. In the new concept (NC) a superstring (SS) is the most elementary structure with functionality. In the NC these entities are anti-commuting spacetime topologies. Their emergence in primordial spacetime breaks its isotopic hydrodynamic symmetry. By quantization of three plane simply connected cobording topologies and their compactification to three-layered toric SS the dark SS stem particles in a supersymmetric theory play the role of gravitons. The dark SS stem particles in a supersymmetric theory play the role of gravitons. The dark SS stem particles in a supersymmetric theory play the role of gravitons. The dark SS stem particles in a supersymmetric theory play the role of gravitons.

Saturday, October 13, 2007 9:00AM - 12:00PM – Session HG Nuclear Structure III – Newport News Marriott at City Center Pearl Salon III

9:00AM HG.00001 Collective Band Structures in Neutron-Rich $^{108}$Mo Nucleus, H.B. DING, S.J. ZHU, Tsinghua University, J.H. HAMILTON, A.V. RAMAYYA, J.K. HWANG, Vanderbilt University, Y.X. LUO, Vanderbilt University, Lawrence Berkeley National Lab, J.O. RASMUSSEN, I.Y. LEE, Lawrence Berkeley National Lab, X.L. CHE, J.G. WANG, Q. XU, Tsinghua University — High spin states in the neutron-rich $^{108}$Mo nucleus were studied by measuring prompt $\gamma$-rays following the spontaneous fission of $^{252}$Cf with the Gammasphere detector array. Our high statistics data, 5.7 x 10$^{13}$ triple coincidences, enabled us to see new bands. The ground-state band is confirmed, and the one-phonon $\gamma$-vibrational band is extended up to spin 12. Three new unexpected states are found to feed into the ground and one-phonon $\gamma$-band $6^+$ and $8^+$ states. A new collective band with a band head at 1422.4 keV is observed with energy spacing similar to the one-phonon $\gamma$-band and feeding only into this band. These data suggest its assignment as a two-phonon $\gamma$-vibrational band. Such bands are seen in $^{104,106}$Mo. Another new band is proposed as a two-quasi-proton excitation band. Systematic characteristics of the collective bands will be discussed.
9:24AM HG.00003 Hyperdeformation in the Cranked Relativistic Mean Field Theory\(^1\). Anatoli Afanasjev, C.W. Jang, J. Begnaud, Mississippi State University — Since the discovery of superdeformation in 152Dy, nuclear hyperdeformation (HD) has been in the focus of attention of the nuclear structure community [1,2]. Recent observation of the very extended shapes in 108Cd (see Ref. [3] for theoretical analysis) and the observation of ridge-structures in 3-dimensional rotational mapped spectra in the A~120 mass region, having features consistent with hyperdeformation [2], have renewed interest in the study of hyperdeformation. Systematic search for hyperdeformation at high spin in the Z~40-60 part of nuclear chart has been performed within the framework of the cranked relativistic mean field (CRMF) theory. Available experimental data (108Cd, ridge-structures in the A~120 mass region) have been compared with the calculations. The CRMF results are also compared with those obtained in the macroscopic-microscopic method [1]: the similarities and differences are outlined. The detailed features of the HD bands have been studied. The regions most favored for experimental observation of the HD discrete bands will be outlined. [1] N. Schuck, et al., Phys. Rev. C75, 054304 (2007), [2] B. Herskind et al., Phys. Scripta T125, 108 (2006), [3] A.V. Afanasjev et al, Phys.Rev. C 72, 031301(R) (2005).

9:36AM HG.00004 Systematic investigations of the stable Cd isotopes\(^1\). P.E. Garrett, K.L. Green, University of Guelph, J.L. Wood, W.D. Kulp, Georgia Tech. — The Cd nuclei, especially the stable even-even isotopes have been well studied since they were suggested as paradigms of the vibrational, or U(5), limit of the Interacting Boson Model (IBM). In addition to the normal quadrupole phonon states, in many cases suggested up to the three-phonon quintuplet, more deformed 2\(\hbar\)\(h\)\(h\) intruder excitations have been established. Recent investigations with the \((n,n'\gamma)\) reaction [1,2,3,4] have provided a wealth of information on the low-lying levels, including many lifetimes not previously known. Deviations in the transition B(E2) values for low-spin states from those expected for U(5) nuclei are observed to appear systematically across the Cd isotopes. We have performed detailed calculations using the IBM-2, and find that these deviations cannot be explained through considered mixings with the intruder excitations or mixed-symmetry states, indicating that some physics is missing in the description of these levels. [1] F. Corminboeuf et al., Phys. Rev. C 63, 014305 (2001). [2] P.E. Garrett et al., Phys. Rev. C 75, 014307 (2007). [3] D. Bandopadhyay et al., to be published. [4] M. Kadi et al., Phys. Rev. 68, 031306 (2003).

9:48AM HG.00005 Cd-128: ugly duckling or provocative young swan\(^1\). W.B. Walters, N. Hotelling, A.A. Hecht, University of Maryland, P.M. Mantica, B.E. Tomlin, J. Pereira, A. Becerril, T. Fleckenstein, G. Lorusso, J.S. Pinter, J.B. Stoker, Michigan State University, M. Quinn, University of Notre Dame — In this presentation, gamma ray spectra will be presented that arise from the decay of microsecond level isomers in 125,126,127,128,129Cd. These nuclei have been produced in fragmentation reactions at the NSCL, and identified using the beta counting system and SEGA gamma-ray detector array. Proposed level schemes for these nuclei will be shown that include the 2\(^+\) and 4\(^+\) energies for 126,128Cd that have been previously identified in radioactive decay. Emphasis will be on the structure of 126Cd for which the proposed 2\(^+\) and 4\(^+\) levels at 645 and 1428 keV, respectively, are far below the results from recent shell-model calculations. These structures are interpreted relative to the level structure below the beam axis. The viability of the technique has been demonstrated. Results will be presented and discussed.

1Work supported in part by the Natural Sciences and Engineering Research Council of Canada.

10:00AM HG.00006 ABSTRACT WITHDRAWN

10:12AM HG.00007 Radioactive beam g-factor measurement of the 2\(^+\) state of \(^{132}\)Te\(^1\). N. Benzcker-Koller, G. Kumbartzki, G. Gurdal, B. Krieger, Rutgers, C. Gross, ORNL, R. Hattarik, P. O’Malley, S. Pain, L. Segen, Rutgers, N. Stone, U. Tenn., A.E. Stuchbery, ANU, C. Baktash, D. Radford, C.-H. Yu, C. Bingham, ORNL, M. Danchev, R. Grzywacz, U. Tenn., R.V.F. Janssens, ANL — The magnetic moment of the Coulomb-excited 2\(^+\) state of \(^{132}\)Te has been measured by the transient field technique using the radioactive beam at HRIBF. Projectile excitation was induced in a C layer backed by either gadolinium or iron ferromagnetic foils. The de-excitation \(\gamma\) ray was detected in a standard four-Clover Ge detector setup in coincidence with recoil C ions recorded in two forward Si detectors subtending angles 19\(^0\) < \(\theta\) < 47\(^0\) above and below the beam axis. The viability of the technique has been demonstrated. Results will be presented and discussed.

1We thank the US NSF and the US DoE for their support.

10:24AM HG.00008 Test of Internal-Conversion Theory with Precise \(\gamma\)- and x-ray Spectroscopy: \(^{134}\)Cs\(^m\) and \(^{137}\)Ba, \(^{139}\)La. N. Nica, J.C. Hardy, C. Balonek, V.E. Iacob, J. Goodwin, H.I. Park, W.E. Rockwell, Texas A&M University, M.B. Trzhaskovskaya, Petersburg Nucl. Phys. Inst. We recently reported [1] a measurement of the ratio of \(K\)-shell internal conversion coefficients, \(\alpha_{K}\), for two transitions; the 127.5-keV E3 in \(^{134}\)Cs and the 661.7-keV M1 in \(^{137}\)Ba. Previous measurements of these \(\alpha_{K}\) values disagreed with calculations. Our new result for the ratio, 30.01(15), disagrees with, but is a factor of three more precise than, the previous average of all experimental results and is consistent with modern Dirac-Fock calculations that include the atomic vacancy in the daughter. This confirms our earlier conclusion [2] that this approach is the best one for \(\alpha_{K}\), a much heavier nucleus. In a new measurement we have now deduced the precise efficiency of our HPGe detector in the energy range of Cs-La K X-rays from the 165.9 keV, M1 transition in \(^{139}\)La, for which the \(\alpha_{K}\) value can be reliably calculated and is nearly independent of whether the atomic vacancy is included or not. Based on this calibration, we have converted our ratio result into individual \(\alpha_{K}\) results for the transitions in \(^{134}\)Cs and \(^{137}\)Ba: viz. \(\alpha_{K}(127.5) = 2.749(16)\) and \(\alpha_{K}(661.7) = 0.0915(6)\). Both results are in good agreement with calculations that include the atomic vacancy. [1] N. Nica et al., Phys. Rev. C75, 054308 (2007); [2] N. Nica et al., Phys. Rev. C70, 054305 (2004).
10:36AM HG.00009 Search for mixed-symmetry states in $^{136}$Ba\(^1\), S. MUKHOPADHYAY, S.N. CHAUDRY, B. CRIDER, E. ELHAMI, J.N. ORCE, E.E. PETERS, M. SCHECK, M.T. MCELLESTREM, S.W. YATES, University of Kentucky — The low-spin structure of $^{136}$Ba reactions was studied at the University of Kentucky with the $(\alpha,\alpha')$ reaction. The primary goal was the identification of the two-phonon mixed-symmetry states built on the first $2^+_1$ at 2129 keV. Furthermore, the systematics and the quadrupole-octupole multi-phonon excitations received special focus. The excitation functions performed from 2.2 MeV to 3.9 MeV helped to determine the threshold for the $\gamma$-ray transitions and hence their placement in the level scheme. Lifetimes, spins, multipolarities, and branching ratios obtained from angular distributions at 2.5 MeV and 3.5 MeV will be presented.

10:48AM HG.00010 From chiral vibration to static chirality in $^{135}$Nd\(^1\), S. MUKHOPADHYAY, University of Notre Dame, Indiana, USA; UGC-DAE CSR, Kolkata Centre, India, D. ALMEHED, U. GARG, S. FRAUENDORF, T. LI, P.V. MADHUSUDHAN RAO, X. WANG, University of Notre Dame, Indiana, USA; S.S. GHUGRE, UGC-DAE CSR, Kolkata Centre, India, M.P. CARPENTER, S. GROS, A. HECHT, R.V.F. JANSSENS, F.G. KONDEV, T. LAURITSEN, D. SEWERYNIK, S. ZHU, Argonne National Laboratory, Argonne, IL, USA — Lifetimes were obtained in a DSAM measurement at Gammasphere, using the $^{100}$Mo($^{34}$Ar, 5n)$^{135}$Nd reaction. Electromagnetic transition probabilities have been measured for the intra- and inter-band transitions in the two spins of the nucleus $^{135}$Nd that were previously identified as a composite chiral bands [1]. The measurements are in good agreement with results of a new combination of TAC and RPA calculations. The chiral character of the bands is affirmed and it is observed that their behavior is associated with a transition from a vibrational into a static chiral regime. [1] S. Zhu et al., Phys. Rev. Lett.91, 132501 (2003).

11:00AM HG.00011 Investigating g-bosons in low-lying mixed symmetry states of $^{140}$Nd, R.J. CASPERSON, E. WILLIAMS, V. WERNER, H. AI, R.F. CASTEN, A. HEINZ, E.A. MCCUTCHAN, J. QIAN, R. WINKLER, WNSL, Yale University, New Haven, CT 06520, G. GÜRDAL, Clark University, Worcester, MA 01610, M. CHAMBERLAIN, Department of Physics, University of Surrey, Guildford, Surrey, UK — $^{140}$Nd was produced through the $^{144}$Pr(p,2n)$^{140}$Nd reaction using a 16 MeV proton beam from the Yale ESTU tandem accelerator. Angular correlation measurements were made in-beam using the newly reconfigured YRAST ball detector array, and will be used to identify the multipolarities of transitions between low-lying states. Low-lying mixed symmetry states in $^{140}$Nd will be identified, and the role of quadrupole and eventually hexadecapole degrees of freedom in these states will be investigated. Preliminary results will be presented. Work supported by US DOE under Grant Numbers DE-FG02-91ER-40609, DE-FG02-05ER-41379, and DE-FG02-88ER-40417.

11:12AM HG.00012 Search for Mixed Symmetry States in $^{138}$Nd, J.R. TERRY, V. WERNER, H. AI, R.J. CASPERSON, A. HEINZ, B. HUBER, R. LÜETTKE, E.A. MCCUTCHAN, J. QIAN, B. SHORAKA, E. WILLIAMS, R. WINKLER, Wright Nuclear Structure Laboratory — Excited states of mixed proton-neutron symmetry have been observed in a number of nuclei—most notably and extensively in $^{94}$Mo [1]. Such states are characterized by strong $M1$ transitions to symmetric partner states and are typically observed at 2-3 MeV excitation in nuclides removed from a close shell by two particles and/or two holes. The neutron-deficient $^{138}$Nd has been populated by beta decay at the Wright Nuclear Structure Laboratory to search for mixed symmetry states four neutrons below the $N=82$ shell closure. Gamma-ray emissions are detected with an array of 6 HPGe clover detectors configured for angular correlations measurements and are analyzed to extract multipolarities and mixing ratios. Analysis is ongoing and results will be presented. This work is supported by the U.S. Dept. of Energy grant no. DE-FG02-91ER-40609.

11:24AM HG.00013 A search for low-lying mixed symmetry states in $^{140}$Nd, E. WILLIAMS, R.J. CASPERSON, V. WERNER, H. AI, WNSL, Yale University, New Haven, CT 06520, P. BOUTACHKOV, Department of Physics and Astronomy, Rutgers University, New Brunswick, New Jersey 08903, R.F. CASTEN, WNSL, Yale University, New Haven, CT 06520, M. CHAMBERLAIN, WNSL, Yale University, New Haven, CT 06520; Department of Physics, University of Surrey, Guildford, Surrey, UK, G. GÜRDAL, WNSL, Yale University, New Haven, CT 06520; Department of Chemistry, Clark University, Worcester, MA 01610, A. HEINZ, E.A. MCCUTCHAN, J. QIAN, R. WINKLER, WNSL, Yale University, New Haven, CT 06520 — Low-lying mixed symmetry states in $^{140}$Nd were populated by $\beta^+$ decay from $^{140}$Sm. Subsequently $\gamma$ decays were observed off-beam at the YRAST Ball spectrometer at Yale University, which has recently been reconfigured for angular correlation studies. Angular correlation measurements will be used to search for possible low-lying mixed-symmetric $2^+$ states. Our results will shed more light on the evolution of mixed symmetry states in the N=80 isotones, as they seem to exhibit a strong dependence on the underlying shell structure. Preliminary results of this investigation will be presented. This work is supported by US DOE grant numbers DE-FG02-91ER-40609, DE-FG02-88ER-40417, DE-FG02-05ER-41379, and the US National Science Foundation.

11:36AM HG.00014 ABSTRACT WITHDRAWN –

11:48AM HG.00015 Shape Coexistence in Transitional Nuclei\(^1\), W.D. KULP, Georgia Institute of Technology, P. SCHMELZENBACH\(^2\), Oregon State University, J.L. WOOD, J.M. ALLMOND, Georgia Institute of Technology, K.S. KRANE, J. LOATS, C.J. STAPELS, Oregon State University, E.B. NORMAN, Lawrence Berkeley National Laboratory — The “transitional” nuclei near $N=90$ have long been a focus of experimental and theoretical investigations. We report on a program of study of the $N=90$ and $N=88$ nuclei with a focus on the structure of $^{150}$Sm elucidated through new high-statistics, precision $\gamma$-ray coincidence spectroscopy and $\gamma-\gamma$ angular correlation data from the radioactive decay of $^{150}$Pm ($T_{1/2}=2.68$ h, $Q_e=3454$ keV, $J^\pi=1^+$) and $^{152m,9}$Eu ($T_{1/2}=12.88$ h, $J^\pi=0^+$ and $T_{1/2}=36.9$ y, $J^\pi=5^{(-)}$, respectively, $Q_e (g.s.)=2261$ keV). In particular, very weak key collective transitions (e.g., the $2^+_2$ ($1046) \rightarrow 4^+_1$ ($737$) 272 keV $\gamma$ ray) are observed and precision $\delta(E2/M1)$ mixing ratios are extracted (determining $\Delta J=0$ transitions). This data, when combined with published results from conversion electron measurements, two-neutron transfer studies, and Coulomb excitation supports the results from detailed multiple-spectroscopy studies of $^{152}$Sm [1] indicating that shape coexistence underlies the structure at $N=88, 90$. [1] W. D. Kulp, et al., arXiv:0706.4129 [nucl-ex].

\(^1\)Work supported in part by U. S. DOE grants/contracts DE-FG02-96ER40958 (Ga Tech), DE-FG03-98ER41060 (OSU), and DE-AC03-76SF00098 (LBNL).

\(^2\)Present address: Point Loma Nazarene University
9:00AM HH.00001 HIE-ISOLDE — R. KRUECKEN, TU Muenchen, Germany, P. BUTLER, University of Liverpool, UK, M. HUYSE, K.U. Leuven, Belgium, D. JENKINS, University of York, M. LINDROOS, K. RIISAGER, CERN, Switzerland, W.B. WALTERS, University of Maryland, USA, HIE-ISOLDE COLLABORATION — The HIE-ISOLDE project proposal is a major staged upgrade to the existing REX accelerator facility at ISOLDE with the objective to provide radioactive beams up to 5.5 MeV/u with a future option of going to 10 MeV/u. The ambition is to make all isotopes produced at ISOLDE (>800) available as post accelerated beams. The beam quality will be much improved for ISOLDE users with the installation of a RFQ cooler, a new improved resonant laser ionization system and a renovated high resolution mass separator. New isotopes will be made available through target and ion source development. The driver intensity will be increased (5x), with a first increase coming from a faster cycling of the PS Booster and a later increase coming from the new Linac-4. The project is designed as a participative project with many sub-tasks in which ISOLDE users are invited to participate. So far, the development and construction of an improved resonant laser ionization system, the construction of an RFQ cooler, and the prototyping of the SC linac are well advanced. We will in this contribution review the project and report on the present status of the staged proposal.

9:12AM HH.00002 Current Status of HELIOS1 — JON LIGHTHALL, Western Michigan University, HELIOS COLLABORATION2 — We are currently in the process of assembling and testing the HELical Orbit Spectrometer (HELIOS) at the ATLAS facility of Argonne National Laboratory. HELIOS is designed to study inverse-kinematic nuclear transfer reactions using exotic beams. These reactions are of particular interest in the studies of nuclear structure away from stability, and in nuclear astrophysics. This new type of spectrometer features a 3 Tesla, 90 cm bore superconducting solenoid. Inside the HELIOS solenoid will be a hollow detector along the magnetic field axis, in-line with the target. The detector consists of a four sided, forty-element array of position-sensitive silicon detectors. This geometry has significant advantages over conventional detectors. HELIOS will be used with secondary in-flight beams produced at ATLAS, and in the future with beams from the CARIBU (California Rare Isotope Beam Upgrade) source. The current status of HELIOS will be presented.

1 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).
2 Western Michigan University, Argonne National Laboratory, Manchester University.

9:24AM HH.00003 NIMROD Upgrade — S. WUENSCHEL, K. HAGEL, Z. KOHLEY, L. MAY, J.B. NATOWITZ, R. WADA, S.A. JENKELLO, Texas A&M University — The 4-pi detection array NIMROD has been recently upgraded. The upgrade increased granularity in the backward direction and improved Si coverage. NIMROD is now composed of 10 forward annular rings (~3-90 degrees) and a hemisphere of the ISIS array (90-176 degrees). Complete Si coverage in the regions of 3-45 and 90-176 degrees. The forward region is composed of ten telescopes of 300 micron Si and CsI as well as two super telescopese of 150 and 500 micron Si with CsI per ring. The ISIS portion has complete Si coverage in the form of 500 micron Si with the CsI. Additionally, modular treatment of signals has been implemented. Handling signals in this way retains the telescope grouping of detectors in the electronics as long as possible. Towards this end, motherboards holding Zepto System preamplifiers were installed on the reaction chamber for preamplification of the Si signals at the earliest opportunity. The improved detector system has been used in a first experiment with 86,78Kr+64,58Ni systems. Performance of the detector system during the experiment will be presented.

9:36AM HH.00004 Determining the Composition of Radioactive Hotspots in the Third Phase of SNO — BRENT VANDEVENDER, University of Washington - CENPA, SNO COLLABORATION — The third and final phase of the Sudbury Neutrino Observatory (SNO) was distinguished from earlier phases by the addition of 40 $^{40}$He-filled proportional counters. Despite great efforts to ensure the cleanliness of construction and installation, early analysis of Cerenkov light revealed three radioactive hotspots on the proportional counter bodies. We present two new methods employed to determine the composition and activity of these spots and their contributions to SNO's solar neutrino-neutral-current interaction backgrounds.

9:48AM HH.00005 Instrumentation of PrimEx Experimental Apparatus — PAWEL AMBROZEWICZ, North Carolina A&T State University, PRIMEX COLLABORATION — A state-of-the-art experimental setup was assembled in the Hall B of Jefferson Lab. A hybrid calorimeter, consisting of a multichannel lead glass detector with segmented high-resolution lead tungstate insert was coupled with a quasi-monochromatic photon beam from the Jefferson Lab Hall B tagged photon facility. Aided by a photon flux monitoring system, the pair spectrometer, this apparatus allows precise measurements of position and energy of forward going particles. This device was recently used in a precision measurement of neutral pion lifetime that was carried out at the Jefferson Lab - the PrimEx experiment. The measurement tested one of the most fundamental symmetry predictions of Quantum Chromodynamics, the axial anomaly, via the Primakoff effect, coherent $e^+e^-$ production off a nuclear Coulomb field. Data collected covered a range of photon energies and angles that allowed clean separation of the Primakoff contribution from competing photoproduction processes. Similar setup would be used to investigate the Primakoff effect in photoproduction of the $\eta$ meson in the 12GeV energy regime of the Jefferson Lab.

10:00AM HH.00006 Precise Determination of Total Absolute Gamma Ray Intensity at HI$^-$S — S. STAVE, M.W. AHMED, M.A. BLACKSTON, M.D. BUSCH, M. EMAMIAN, S.S. HENSHAW, C.R. HOWELL, J. LI, S. MIKHAILOV, B.A. PERDUCE, G. SWIFT, H.R. WELLER, Y.K. WU, Duke U. & TUNL — Precision determination of cross sections requires precise knowledge of the incident $\gamma$-ray intensity. For this purpose, six precision machined copper attenuators have been installed in the beamline of the High Intensity Gamma Source (HI$^-$S) located on the Duke University campus. Each of the attenuators is individually mounted and controlled remotely. To decrease background, the attenuator system is located near the exit of the storage ring about 50 meters from the location of the target. The Cu attenuation coefficients were determined for several $\gamma$-ray energies between 2.3 MeV and 40 MeV and then the attenuated beam intensity was measured in a 10x14 inch NaI detector. Different combinations of the attenuators were used to test their effect on the $\gamma$-ray beam looking for differences in counts and resolution. Then the total, unattenuated intensity was calculated using the deadtime corrected integrated peak counts from the NaI along with the measured Cu attenuation coefficients. The results for attenuation coefficients and total intensity are in good agreement with existing attenuation data, intensity calculations and known cross sections. A detailed analysis of the uncertainties in the measured intensities will be presented along with a description of the system.

10:12AM HH.00007 The PHENIX Silicon Vertex Detector Upgrade — ERIC MANNEL, Columbia University, PHENIX COLLABORATION — The PHENIX experiment is designed to study the properties of the dense nuclear matter created in relativistic heavy ion collisions. In order to enhance the physics capabilities of the PHENIX detector, a silicon vertex detector (VTX) is being constructed to provide precise tracking and vertex reconstruction over the full rapidity and azimuthal range of the central spectrometer. By identifying displaced decay vertices, the VTX will be able to identify heavy quark production in proton-proton and heavy ion collisions. In addition, the VTX will be able to reconstruct jets over a large acceptance. The VTX is comprised of a four-layer barrel, with two inner pixel sensor layers and two outer strip sensor layers. This presentation will provide details of the physics capability added to PHENIX by the VTX, the technology choices of the design, and the current status of the project.

10:24AM HH.00008 The FVTX upgrade detector at PHENIX — HUBERT VAN HECKE, Los Alamos National Laboratory — A forward silicon detector is being designed for PHENIX. The device will cover pseudorapidities $\pm(1.2-2.4)$, matching the acceptance of the muon detectors, and is designed to greatly enhance the heavy-flavor physics capabilities of the experiment. The FVTX will consist of two sets of four disks of silicon mini-strips, with a fast readout system that will allow input to the level-1 trigger. I will describe the proposed device, and show results from a prototype readout chain.
10:36AM HH.00009 Design and Performance of Reaction Plane Detector in PHENIX, RUI WEI, Stony Brook University, PHENIX COLLABORATION — Measuring the event anisotropy of nucleus-nucleus collisions is one of the most important methods to investigate the hot dense partonic matter produced at RHIC. Along with the discovery of jet suppression, the observation of large v2 leads to the conclusion that the strongly coupled medium is formed in Au+Au collisions. However, the v2 measurements of rare observables such as electrons, photons, J/ψ and high pT particles are constrained by the low statistics and reaction plane resolution. By installing a new reaction plane detector at PHENIX, the resolution is improved by factor of 2. This enables us to further study the v2 of rare probes and even to extend our view to v3. In the talk the performance of this new detector in this year’s run will be discussed.

10:48AM HH.00010 High pT PID using Time-of-Flight with Multi-gap Resistive Plate, RONALD BELMONT, Vanderbilt University, PHENIX COLLABORATION — In Run7 of RHIC the PHENIX experiment operated a Time-of-Flight detector based on Multi-Gap Resistive Plate Chambers. The detector covers an area of 8 m2 in the PHENIX West arm spectrometer and together with the previously installed Aerogel Cherenkov Counters (ACC) completes the high-pT particle identification (PID) upgrade in PHENIX. Intrinsic detector timing resolution of 80 ps has been achieved, which allows for 4 σ/K separation up to pT ~ 3 GeV/c and K/p separation up to pT ~ 5 GeV/c. Combined with ACC, the new detector system provides seamless PID for p/T/K/p in the range 0.2 < pT < 9 GeV/c. The PID for resonances has been extended to even higher (> 10 GeV/c) pT. The track-by-track identification with increased angular coverage allows for jet correlation measurements with PID in both the near side and away side jet cones. Jets have been shown to be significantly modified in heavy ion collisions at RHIC when compared to the p+p reference data. Identified particle measurements at high pT are a key to understanding the underlying jet suppression mechanisms. The MRPC-TOF performance and the extended physics capabilities of PHENIX will be discussed.

11:00AM HH.00011 Pressure and temperature dependence of gas amplification gains in R134a-isobutane-SF6 mixtures for RPCs, JOHN WOOD, Abilene Christian University, PHENIX COLLABORATION — The PHENIX first level muon trigger upgrade will include dedicated muon tracking spectrometers based on resistive plate chamber (RPC) technology. We have studied the pressure and temperature dependence of gas amplification in typical gas mixtures expected for the RPC application in PHENIX.

11:12AM HH.00012 Design and R&D for the PHENIX Muon Trigger RPCs, YOUNG JIN KIM, University of Illinois at Urbana-Champaign, PHENIX COLLABORATION — Resistive Plate Chambers (RPCs) have been widely used for trigger or time-of-flight applications in high energy physics and nuclear physics experiments. The PHENIX experiment at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory (BNL) upgrades its first level muon trigger with tracking stations of double-gap RPCs. This will make it possible to study flavor separated quark and anti-quark polarizations of the proton by measuring the spin dependent yields of W-bosons in polarized proton-proton collisions. The RPC design for the PHENIX muon trigger is based on technology developed for the CMS endcap muon trigger RPCs. In this talk we introduce the general detector design and discuss the results of RPC detector performance R&D carried out at several PHENIX institutions with different prototypes, including prototypes manufactured in the CMS RPC factory at Korea University in Seoul.

11:24AM HH.00013 A Cosmic Ray Test Stand for the PHENIX Muon Trigger RPCs, BEAU MEREDITH, Graduate Student at UIUC/PHENIX — Resistive Plate Chambers (RPC’s) will be used in the first level muon trigger for W events in the PHENIX detector at RHIC. As technology for the upgrade for PHENIX has chosen fast CMS muon trigger bakelite RPCs. In order to understand RPC’s and to gain experience in operating them, institutions within the PHENIX collaboration have undertaken an intense research effort in which they both develop and test RPC’s. In this presentation we will describe the cosmic ray test stand setup at the University of Illinois at Urbana and present some of the results we have obtained. In particular, we shall present results for the efficiency, position resolution, timing resolution, and cluster size for RPC prototypes developed at UIUC.

11:36AM HH.00014 Near-Real Time Reconstruction of Minimum Bias Au+Au collisions at √s_{NN}=200 GeV Using Remote Computer Resources Through GRID Networking, BRIAN LOVE, Vanderbilt University, PHENIX COLLABORATION — Near-real time reconstruction of minimum bias Au+Au collision data at √s_{NN}=200 GeV from the PHENIX experiment at RHIC has been sustained over a 7 week period, proving the feasibility of future longer duration efforts. CPU resources from the ACCRE computing facility at Vanderbilt University were used for data production, while the Open Science GRID infrastructure was utilized for large volume data transfers to and from the RHIC Computing Facility (RCF). During this trial, raw data files were transferred daily from PHENIX to ACCRE and, through an automated pipeline, the files were processed and the output returned to RCF just days later at a rate of 5TB a week. Fault tolerant mechanisms were developed to ensure a robust operation with an absolute minimum of manual intervention. With the incorporation of this facility into PHENIX data processing, the power of GRID networking to combine computing resources from diverse geographical locations has been confirmed. With fast analysis turnaround of raw data, more opportunities are provided for near-real time decision making in PHENIX.

Saturday, October 13, 2007 2:00PM - 4:24PM — Session JA From Nucleons to the Origins of Nuclei Newport News Marriott at City Center Grand Salon I

2:00PM JA.00001 The Various Proposed Mechanisms of Core-collapse Supernova Explosions: A Status Report, ADAM BURROWS, University of Arizona — The explosion mechanism for core-collapse supernova explosions has exercised theorists for more than four decades. During that time, much progress was made in understanding the basic physics and hydrodynamics, but no robust, definitive, and satisfactory solution emerged. Although, the neutrino-driven heating mechanism is still the favorite of most researchers, it has not been demonstrated to work generically, particularly in 1D and 2D simulations. Recently, an acoustic mechanism and magnetohydrodynamic jets have been added to the mix and it has been shown that the majority of gamma-ray bursts must be associated with a small subset of core collapses. Moreover, a new class of energetic supernovae (“hypernovae”) have been discovered. As a result, the study of the supernova mechanism has assumed a far wider portfolio and a greater richness than ever in the past. In this talk, I will discuss the menu of explosion mechanisms now available, and the status of multi-dimensional numerical simulations of the death of massive stars, the birth of neutron stars and black holes, and the origin of the elements. A theme of this talk will be the synergistic roles played by both sophisticated numerical simulation and nuclear physics, in all its particulars, in one of nature’s most dramatic and important phenomena.
2:36PM JA.00003 Electric Form Factor of the Neutron, ROBERT FEUERBACH, The College of William and Mary — Recent polarization-based precision measurements of the nucleons' elastic electric form factors have led to surprising results. The measurement of the ratio of the proton's electromagnetic form factors, $\mu_p G_E^p/G_M^p$, was found to drop nearly linearly with $Q^2$ out to at least 5 GeV$^2$, inconsistent with the older Rosenbluth-type experiments. A recent measurement of $G_E^p$ the neutron’s electric form-factor saw $G_E^p$ does not fall off as quickly as commonly expected up to $Q^2 \approx 1.5$ GeV$^2$. Extending this study, a precision measurement of $G_E^p$ up to $Q^2 = 3.5$ GeV$^2$ was completed in Hall A at Jefferson Lab. The ratio $G_E^p/G_M^p$ was measured through the beam-target asymmetry $A_1$ of electrons quasi-elasitically scattered off polarized neutrons in the reaction $^3\text{He}(e,e'n)$. The experiment took full advantage of the electron beam, recent target developments, as well as two detectors new to Jefferson Lab. The measurement used the accelerator’s 100% duty-cycle high-polarization (typically 84%) electron beam and a new, hybrid optically-pumped polarized $^3\text{He}$ target which achieved in-beam polarizations in excess of 50%. A medium acceptance (80msr) open-geometry magnetic spectrometer (BigBite) detected the scattered electron, while a geometrically matched neutron detector observed the struck neutron. Preliminary results from this measurement will be discussed and compared to modern calculations of $G_E^p$.

3:12PM JA.00003 Two-proton decay of $^{45}$Fe$^1$, ROBERT GRZYWACZ, University of Tennessee — The decay of the extremely neutron deficient $^{45}$Fe is the best candidate to study two proton radioactivity. This process was first predicted in 1960 by V.I. Goldansky to occur for only very few nuclei near the proton drip-line, for which the emission of the single proton is energetically forbidden, due to the pairing interaction. It was hypothesized, that the two protons will be emitted as a strongly correlated pair, a di-proton. Since then other scenarios have been predicted. The measurement of angular correlation between protons should provide an experimental signature for the nature of this process. In the recent experiment, performed at the NSCL at the Michigan State University, decay of $^{45}$Fe has been studied in detail using a new type of gaseous detector developed at the Warsaw University. Two-proton radioactivity channel was clearly identified. The production rate of the $^{45}$Fe nuclei was sufficient to measure enough events to determine the distribution of the angular correlations between the protons indicating a three-body character of this decay. Details of the experiment and the results will be presented.

3:48PM JA.00004 Shell Model Approach to Many-Body Open Quantum Systems$^2$, JIMMY ROTUREAU, Oak Ridge National Laboratory/University of Tennessee — The theoretical description of weakly-bound/unbound nuclei requires the treatment of the many-body correlations, the continuum of positive-energy states and decay channels. Solution of this problem has been advanced recently in the open quantum system formulation of the nuclear shell model (SM), the so-called Gamow Shell Model (GSM). GSM is the SM with a single-particle (s.p.) basis given by the Bergren ensemble consisting of Gamow states and the non-resonant continuum of scattering states. The principal limitation of GSM applications is the explosive growth in the number of configurations both with the number of particles and the size of the s.p. space. To ensure completeness of the basis, one should include a large set of non-resonant continuum states. Because of their presence, the dimension of the matrix representing the Hamiltonian $H_{\text{GSM}}$ grows extremely fast and this matrix is also significantly denser than that of a conventional SM. To overcome these difficulties, we propose a method based on the density matrix renormalization group (DMRG) approach for finding the eigenstates of $H_{\text{GSM}}$. During my presentation I will show results we obtained for the description of weakly-bound/unbound states for Helium and Lithium isotopes.

Saturday, October 13, 2007 2:00PM - 3:48PM – Session JB Mini-Symposium on DiJets and Correlations in Heavy Ion Collisions II Newport News Marriott at City Center Grand Salon III

2:00PM JB.00001 Probing the QGP Structure at RHIC with Jet-Medium Correlations, STEFFEN BASS, Duke University — The study of di-jet production and multi-particle correlations involving at least one hard particle has developed into an important tool for probing the properties of the QGP produced at RHIC. In the first part of my talk I will focus on how jet-medium correlations, such as the azimuthal dependence of jet energy-loss can help constrain the various approaches used to describe jet-medium interactions (i.e. BDMPS, Higher Twist and AMY). In the second part of my talk I will study the interactions of jets with turbulent color fields and their implications for observables at RHIC. The near-side distribution of particles at intermediate transverse momentum, associated with a high momentum trigger hadron, is broadened in rapidity compared with the jet cone. This broadened distribution is thought to contain the energy lost by the progenitor parton of the trigger hadron. I will show that the broadening can be explained as the final-state deflection of the gluons radiated from the hard parton inside the medium by soft, transversely oriented, turbulent color fields that arise in the presence of plasma instabilities. The magnitude of the effect is found to grow with medium size and density and diminish with increasing energy of the associated hadron.

2:36PM JB.00002 Azimuthal anisotropy of charged hadrons in Au+Au and Cu+Cu collisions at RHIC, MICHAEL ISSAH, Vanderbilt University, PHENIX COLLABORATION — The azimuthal anisotropy in particle emission is an important probe for the early dynamics of heavy-ion collisions. At RHIC, it has been well described by hydrodynamic models for transverse momenta below $\sim 2$ GeV/$c$. Recombination models have been invoked to explain the baryon/meson difference and the unexpectedly high strength of the signal at intermediate $p_T$. At high $p_T$, the azimuthal asymmetry in the particle spectra can be attributed to jet quenching. The PHENIX Collaboration has recorded high statistics Au+Au and Cu+Cu collisions at center-of-mass energies in the range 62.4-200 GeV. The azimuthal anisotropy of charged hadrons obtained over a broad $p_T$ range will be presented and discussed. In particular, results from a cumulant analysis will be compared to the standard reaction plane method of flow analysis.

2:48PM JB.00003 Multi-hadron correlations for jet-studies at RHIC, MARTIN ANDREWS, UIC, STAR COLLABORATION — Ultra-relativistic heavy-ion collisions provide a unique environment for the experimental study of a de-confined partonic medium not seen in more elementary (e.g. pp and d+Au) collisions. Modification of jet-like shapes observed via azimuthal di-hadron correlations in central Au+Au collisions gave rise to theoretical investigation of various jet-quenching scenarios as a possible explanations of jet-medium interactions (Cherenkov gluon radiation, mach-cone shock waves, and others). We use a new three-particle correlation technique to select di-jet events in ultra-relativistic Au+Au collisions and explore jet production, fragmentation and jet energy loss mechanisms in the dense medium created in such collisions at RHIC. Jet shapes and yields extracted from di-hadron jet-axis projections in three-particle correlations for Au+Au events of various centralities are compared to those measured in pp and d+Au events and a simple two-component model is used to visualize potential effects of energy loss.

3:12PM JA.00003 Two-proton decay of $^{45}$Fe$^1$, ROBERT GRZYWACZ, University of Tennessee — The decay of the extremely neutron deficient $^{45}$Fe is the best candidate to study two proton radioactivity. This process was first predicted in 1960 by V.I. Goldansky to occur for only very few nuclei near the proton drip-line, for which the emission of the single proton is energetically forbidden, due to the pairing interaction. It was hypothesized, that the two protons will be emitted as a strongly correlated pair, a di-proton. Since then other scenarios have been predicted. The measurement of angular correlation between protons should provide an experimental signature for the nature of this process. In the recent experiment, performed at the NSCL at the Michigan State University, decay of $^{45}$Fe has been studied in detail using a new type of gaseous detector developed at the Warsaw University. Two-proton radioactivity channel was clearly identified. The production rate of the $^{45}$Fe nuclei was sufficient to measure enough events to determine the distribution of the angular correlations between the protons indicating a three-body character of this decay. Details of the experiment and the results will be presented.

3:48PM JA.00004 Shell Model Approach to Many-Body Open Quantum Systems$^2$, JIMMY ROTUREAU, Oak Ridge National Laboratory/University of Tennessee — The theoretical description of weakly-bound/unbound nuclei requires the treatment of the many-body correlations, the continuum of positive-energy states and decay channels. Solution of this problem has been advanced recently in the open quantum system formulation of the nuclear shell model (SM), the so-called Gamow Shell Model (GSM). GSM is the SM with a single-particle (s.p.) basis given by the Bergren ensemble consisting of Gamow states and the non-resonant continuum of scattering states. The principal limitation of GSM applications is the explosive growth in the number of configurations both with the number of particles and the size of the s.p. space. To ensure completeness of the basis, one should include a large set of non-resonant continuum states. Because of their presence, the dimension of the matrix representing the Hamiltonian $H_{\text{GSM}}$ grows extremely fast and this matrix is also significantly denser than that of a conventional SM. To overcome these difficulties, we propose a method based on the density matrix renormalization group (DMRG) approach for finding the eigenstates of $H_{\text{GSM}}$. During my presentation I will show results we obtained for the description of weakly-bound/unbound states for Helium and Lithium isotopes.

$^1$ This work was supported by Polish Ministry of Science and Higher Education number 1 P03B 138 30 , the U.S. National Science Foundation, and the U.S. Department of Energy under contracts DE-FG02-96ER40983 and DEFC03-03NA00143.

$^2$In collaboration with Nicolas Michel, University of Kyoto; Marek Ploszajczak, GANIL, France; Wittek Nazarewicz, ORNL/UT; and Jorge Dukelsky, Instituto de Estructura de la Materia.
3:00PM JB.00004 Fast Partons as a Source of Energy and Momentum in a Thermal Quark Gluon Plasma  
RICHARD NEUFELD, Duke University — An interesting problem in the study of quark gluon plasma (QGP) physics is to determine the effect of fast partons on the bulk behavior of the evolving medium. Recent experimental results supporting the possible formation of a mach cone make this problem all the more relevant. One promising approach to determine the influence of a fast parton on an evolving QGP is to treat the energy and momentum deposited by the parton as a perturbation on the bulk hydrodynamic equations governing the system. I will present results for such a perturbative source term calculated in the context of a Vlasov-Boltzmann evolution.

3:12PM JB.00005 Positive and negative 2- and 3-particle correlations: what about hadron-proton correlation?  
GUOLIANG MA, Purdue University, STAR COLLABORATION — Multi-particle (2- and 3-) azimuthal correlation is thought as a good probe to explore the properties of strongly interacting partonic matter in central Au+Au collisions at RHIC. Especially, 3-particle correlation has a great potential to identify the production mechanism(s) of observed Mach-like correlation. Different from the previous analysis on multi-particle correlation as a good probe to explore the properties of strongly interacting partonic matter in central Au+Au collisions at RHIC. We present observed 2- and 3- particle $h^{-} - p$ correlations, and the corresponding implications will be discussed.

3:24PM JB.00006 Multi-hadron triggered azimuthal correlations in Au+Au Collisions at $\sqrt{s_{NN}} = 200$ GeV from STAR  
BROOKE HAAG, UC Davis — Di-hadron correlation measurements have been used to probe di-jet production in heavy ion collisions at RHIC. A strong suppression of the away-side yield in these measurements is direct evidence that high-pT partons lose energy as they traverse the strongly interacting medium that is formed in ultra-relativistic heavy ion collisions. However, recent studies have shown that the momentum of the trigger particle is not a good measure of the jet energy. As a result, azimuthal di-hadron correlations have limited sensitivity to the shape of the fragmentation function itself. As an attempt at better constraining the initial parton energy we employ a multi-hadron triggered azimuthal correlation analysis. We present first results of multi-hadron triggered correlated yields in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV from STAR. The results are compared to d+Au collisions and we discuss the implications for jet quenching.

3:36PM JB.00007 3-D Source Functions at RHIC from the AMPT Model  
ZI-WEI LIN, East Carolina University — We present results from the AMPT model on pion source functions in Au+Au collisions at RHIC, including source functions along the out, side and long directions. Effects of kinematical cuts on both source functions and correlation functions will be studied. Previously the AMPT model has roughly reproduced the pion correlation functions at 130AGeV in Au+Au collisions (Phys. Rev. Lett. 89, 152301, 2002) as well as the fitted radius parameters (Phys. Rev. C 72, 064901, 2005). Here we compare with available data on both source functions and correlation functions at RHIC, and investigate possible reasons in case of inconsistencies.

Saturday, October 13, 2007 2:00PM - 3:36PM —
Session JD Mini-Symposium on Radioactive Beams and Observations in Nuclear Astrophysics
II Newport News Marriott at City Center Grand Salon IV

2:00PM JD.00001 New Insights and Opportunities from Thermonuclear X-ray Bursts  
TOD STROHMAYER, NASA/GSFC, SUDIP BHATTACHARYYA, UMD/GSFC — The last decade has seen great strides in our observational understanding of thermonuclear X-ray bursts from accreting neutron stars. This observational renaissance has largely been enabled by sensitive, high time resolution observations with NASA's Rossi X-ray Timing Explorer (RXTE). These new observations provide an opportunity to probe neutron stars, and their complex physics, with unprecedented detail. I will discuss recent work on observations and modeling of double-peaked bursts and burst oscillations. This will include a description for uncertain neutron stars as well, as highlighting the important connections to the nuclear physics which ultimately drives the bursts.

2:12PM JD.00002 Measurements of Lifetimes of States in $^{19}$Ne and the $^{15}$O($\alpha,\gamma$)$^{19}$Ne Reaction Rate$^1$  
BARRY DAVIDS, TRIUMF, MYTHILI SUBRAMANIAN, TRIUMF and University of British Columbia — We have measured the lifetimes of several states in $^{19}$Ne above the $\alpha$ emission threshold important in the $^{15}$O($\alpha,\gamma$)$^{19}$Ne reaction. Combining these and other lifetime measurements with measurements of the $\alpha$ decay branching ratios of these states, we evaluate the rate of the $^{15}$O($\alpha,\gamma$)$^{19}$Ne reaction and discuss its role in Type-I X-ray bursts.

$^1$This work was supported by the Natural Sciences and Engineering Research Council of Canada. TRIUMF receives federal funding via a contribution agreement through the National Research Council of Canada.

2:24PM JD.00003 High precision $^{21}$Mg(p,t)$^{22}$Mg reaction to determine the $^{18}$Ne($\alpha,p$)$^{21}$Na reaction rates  
A. MATIC, A.M. VAN DEN BERG, H.J. WÖRTCHE, M.N. HARAKEH, T. ADACHI, Y. FUJITA, Y. SHIMBARA, H. FUJITA, K. FUJITA, K. HATANAKA, Y. SAKEMI, Y. SHIMIZU, Y. TAMESHIGE, A. TAMIL, M. YOSOI, J. GÖRRES, P. LEBLANC, M. WIESCHER, G.P.A. BERG, S. O'BRIEN, H. SCHATZ, T. WAKASA, JINA COLLABORATION, KVI GRONINGEN TEAM, RCNP OSAKA TEAM — The direct measurements of astrophysically interesting reactions are best possible tools in order to investigate stellar reaction rates. Often indirect techniques can be used to obtain nuclear physics information needed by astrophysical models. We performed $^{21}$Mg(p,t)$^{22}$Mg experiment at RCNP by use the Grand Raiden spectrometer and the WS beam line. In this experiment we achieved an unprecedented resolution of 13 keV for (p,t) experiment and we were able to resolve 12 new levels in $^{22}$Mg. We showed that for $^{18}$Ne($\alpha,p$)$^{21}$Na reaction the most dominant resonances at low stellar temperatures are very closely spaced resonances between 8.2-8.6 MeV. Present experiment gave a valuable data necessary for the calibration and guidance for the future direct experiments. We showed that reaction resolution for the direct $^{18}$Ne($\alpha,p$)$^{21}$Na reaction measurements need to be about 30 keV. The experimental technique will be discussed, experimental results and reaction rates will be presented.
2:36PM JD.00004 Indirect rp-process Rate Measurements from Single Neutron Removal. A.M. AMTHOR, D. BAZIN, A. BECERRIL, A. COLE, J. COOK, A. ESTRADER, A. GADE, M. HOWARD, G. LORUSO, M. MATOS, J. PEREIRA, M. PORTILLO, H. SCHATZ, B. SHERRILL, K. SMITH, A. STOLZ, D. WEISSHAAR, R.G.T. ZEGERS, National Superconducting Cyclotron Laboratory, East Lansing, MI, D. GALAVIZ, Instituto de Estructura de la Materia, CSIC, Madrid, A. CHEN, MC Hammer University, Hamilton, ON, ZS. FULOP, ATOMKI, Debrecen, E. SMITH, The Ohio State University, Columbus, OH, M. WIESCHER, University of Notre Dame, Notre Dame, IN — The structure of nuclei along the rp-process path in Type I X-ray bursts has been studied using neutron removal from radioactive beams produced at the National Superconducting Cyclotron Laboratory. Recently, $^{37}$Ca and $^{36}$K have been studied in this way to reduce the uncertainty in $^{35}$Ar(p,$\gamma$)$^{36}$K and $^{36}$K(p,$\gamma$)$^{37}$Ca reaction rates, which are important during burst rise. Under burst conditions these rates are dominated by resonant capture contributions from individual resonances because of the low level density just above the proton threshold, precluding the use of statistical methods based on level density to determine the reaction rates. Therefore, precise structure measurements are required to reduce the orders of magnitude rate uncertainty in these key reactions and thereby constrain X-ray burst models. Preliminary results will be presented along with the implications for X-ray burst models.

This work is supported in part by the U. S. Department of Energy under grant No. DE-FG02-91ER-40699.

1Supported by the National Science Foundation under grant No. PHY06-06007 and PHY05-20930.

2Present address: Hanford.

3Present address: Catalunya.

2:48PM JD.00005 Nuclear energy levels of $^{31}$S and astrophysical implications. C. WREDE, Yale U., J.A. CAGGIANO, TRIUMF, J.A. CLARK, C. DEIBEL, Yale U., D.A. HUTCHIEON, TRIUMF, R. LEWIS, U. of York, A. PARikh, P.D. PARKER, Yale U., C. WESTERFELDT, Duke U. — Nuclear synthesis in the mass range from silicon to calcium in oxygen-neon nova is heavily influenced by the unmeasured strength of the $^{30}$P(p, $\gamma$)$^{31}$S reaction. We have studied the $^{31}$P($^3$He, $t$)$^{31}$S and $^{31}$P($^3$He, $t$)$^{31}$S($^3$P) reactions to measure resonance energies and proton branching ratios in the $^{30}$P + p system. Our results will be presented in the context of novae, x-ray bursts and oxygen burning in massive stars. A direct measurement of resonance strengths in the $^{30}$P(p, $\gamma$)$^{31}$S reaction is planned for the future.

3:00PM JD.00006 First experimental evidence of the rp-process nucleus $^{96}$Cd. A. BECERRIL REYES, V. ANDREEV, B. AREND, D. BAZIN, M. DOLEANS, R. FONTUS, P. GLENNON, P. MANTECA, J. OTTARSON, D. SANDERSON, H. SCHATZ, J. STOKER, O. TARRASOV, J. VINCENT, J. WAGNER, X. WU, A. ZELLER, National Superconducting Cyclotron Laboratory, Michigan State University — The rapid proton capture process has been proposed as the mechanism that powers the observed type I X-ray bursts in the universe. The time scale for the rp-process is governed by the beta-decay half-lives of several even-even N = Z waiting point nuclei, in particular $^{96}$Cd is the only one with an unknown beta decay half-life between $^{56}$Ni and $^{100}$Sn. The recently built Radio Frequency Fragment Separator (RFSS) at the NSCL filters out unwanted particles in rare proton rich beams according to their velocities, thus improving the beam purity by several orders of magnitude. The RFSS was successfully commissioned in May 2007 and used to identify $^{96}$Cd nuclei for the first time. Preliminary results on the production rate of $^{96}$Cd will be presented.

3:12PM JD.00007 St. George a first step toward a recoil separator for FRIB. MANOEL COUDER, GEORG P. BERG, JOACHIM GOERRES, LARRY O. LAMM, P.J. LEBLANC, EDWARD STEECH, MICHAEL WIESCHER, University of Notre Dame — In explosive environments, nuclear reactions involving radioactive ions play a crucial role. The advent of high intensity radioactive beams triggered the development of recoil separators to study proton and $\alpha$ radiative capture. However, existing devices have typically been designed based on a single reaction which limits, de facto, their specifications. At the University of Notre Dame, a large acceptance recoil separator to study radiative capture induced by stable beams (A<40) has been developed. Based on our experience we will expose the possible directions of a separator for FRIB (Facility for Rare-isotope Beams) dedicated to the study of reaction of astrophysical interest.

3:24PM JD.00008 The JINA Reaclib Database and Nuclear Astrophysics Applications. RICHARD CYBURT, HENDRIK SCHATZ, KARL SMITH, SCOTT WARREN, MSU/NSCL — Nuclear astrophysics is a rich and vital field of study, using experimental/theoretical input for calculations of processes that create the elements we are made from. In order to facilitate this research further, the Joint Institute for Nuclear Astrophysics (JINA) has created a public, web-based database for nuclear reaction rates. Data are stored in the standard Reaclib format and are continually updated as new data or new compilations become available. A versioning system has been adopted to keep track of new rates. Recommended rate libraries representing “snap shots” of the live database are stored for users wanting a fixed/unchanging set of rates. The database and its use will be presented with emphasis on its role in nuclear astrophysics calculations. For more information, see the JINA Reaclib website: http://www.nscl.msu.edu/~libraries

Saturday, October 13, 2007 2:00PM - 4:12PM –
Session JE Hadronic Systems Newport News Marriott at City Center Grand Salon V

2:00PM JE.00001 Global Fit to the Nucleon Strange Electromagnetic Form Factors. JIANGLAI LIU, MICHAEL J. RAMSEY-MUSOLF, ROBERT D. MCEWON, California Institute of Technology — The strange electric and magnetic form factors of the nucleon, $G_E^s$ and $G_M^s$, give the contributions of strange quarks to the charge and magnetization distributions of the nucleon, which solely arise from the sea of $\bar{s}s$, $G_E^s$ and $G_M^s$ can be determined by combining the well-known electromagnetic form factors of the proton and the neutron, $G_E^p$ and $G_M^p$, with the neutral weak form factors of the proton, $G_E^{\rho N}$ and $G_M^{\rho N}$, which can be measured via parity-violating (PV) elastic electron scattering. In the past 10 years, a series of definitive PV electron scattering experiments along with several theoretical studies now provide a basis for extracting precision information on these strange quark contributions. In this talk, we report the results of a global analysis of all these experiments, including both the latest data obtained in experiments performed at the Jefferson Laboratory and appropriate theoretical input on radiative corrections, and obtain values for the strange electric and magnetic form factors of the nucleon at a four-momentum transfer $Q^2 = 0.1$ GeV/c$^2$. 

2:36PM JD.00004 Indirect rp-process Rate Measurements from Single Neutron Removal. A.M. AMTHOR, D. BAZIN, A. BECERRIL, A. COLE, J. COOK, A. ESTRADER, A. GADE, M. HOWARD, G. LORUSO, M. MATOS, J. PEREIRA, M. PORTILLO, H. SCHATZ, B. SHERRILL, K. SMITH, A. STOLZ, D. WEISSHAAR, R.G.T. ZEGERS, National Superconducting Cyclotron Laboratory, East Lansing, MI, D. GALAVIZ, Instituto de Estructura de la Materia, CSIC, Madrid, A. CHEN, MC Hammer University, Hamilton, ON, ZS. FULOP, ATOMKI, Debrecen, E. SMITH, The Ohio State University, Columbus, OH, M. WIESCHER, University of Notre Dame, Notre Dame, IN — The structure of nuclei along the rp-process path in Type I X-ray bursts has been studied using neutron removal from radioactive beams produced at the National Superconducting Cyclotron Laboratory. Recently, $^{37}$Ca and $^{36}$K have been studied in this way to reduce the uncertainty in $^{35}$Ar(p,$\gamma$)$^{36}$K and $^{36}$K(p,$\gamma$)$^{37}$Ca reaction rates, which are important during burst rise. Under burst conditions these rates are dominated by resonant capture contributions from individual resonances because of the low level density just above the proton threshold, precluding the use of statistical methods based on level density to determine the reaction rates. Therefore, precise structure measurements are required to reduce the orders of magnitude rate uncertainty in these key reactions and thereby constrain X-ray burst models. Preliminary results will be presented along with the implications for X-ray burst models.

This work is supported in part by the U. S. Department of Energy under grant No. DE-FG02-91ER-40699.

1Supported by the National Science Foundation under grant No. PHY06-06007 and PHY05-20930.

2Present address: Hanford.

3Present address: Catalunya.
2:12PM JE.00002 Strangeness Contributions to the Static Properties of the Proton. KENT PASCHKE, University of Virginia, HAPPEX COLLABORATION — Precision measurements of parity violation in electron-nucleus elastic scattering at low $Q^2$ are sensitive to the strange quark magnetic moment and the strange-charge radius of the proton, and thus provide a unique opportunity to cleanly isolate the role of the quark-antiquark sea in low-energy Quantum Chromodynamics. While recent results have placed a tight upper-bound on strange quark contributions to the electric form-factor at low $Q^2$, significant ($\sim$10%) contributions to the proton magnetic moment are still allowed by the existing data. Results from recently completed measurements of backward-angle scattering, by the G0 and A4 collaborations, will provide an improved sensitivity to the strange magnetic form-factor $G_M^s$ of the proton as well as to axial radiative corrections which are otherwise poorly constrained by existing data. An important complement to those measurements is the HAPPEX-III experiment, which will measure forward-angle scattering at $Q^2 \sim 0.62$ GeV$^2$ with a much greater precision than has previously been achieved in that kinematic range, with a sensitivity to the linear combination of strange-quark vector form-factors $G_V^s + 0.48 G_M^s$. In combination with the published results from low $Q^2$, this measurement will play a crucial role in determining the possible strange quark contribution to the magnetic moment of the proton.

2:24PM JE.00003 Parity-Violating Asymmetry in the Nucleon to Delta Transition. C.L. CAPUANO, College of William and Mary, G0 COLLABORATION — The G0 collaboration at Jefferson Lab has taken data on the parity-violating asymmetry for the inelastic scattering of electrons from the proton. Data were obtained for inclusive pion electroproduction at two beam energies (362 MeV and 687 MeV), with the scattered electrons detected at backward angle ($\theta'_e \sim 110^\circ$). These data will be used to extract the axial vector transition form factor $G_A^\pi$ as a function of $Q^2$ for $0.05$ GeV$^2$/c$^2 < Q^2 < 0.5$ GeV$^2$/c$^2$. $G_A^\Delta$ characterizes the intrinsic spin response of the nucleon during its transition to its first excited state. This experiment represents the first determination of this quantity using a neutral current probe. Data obtained with a deuterium target will also be studied. The status of the data analysis for both hydrogen and deuterium will be presented.

2:36PM JE.00004 Exclusive Electroproduction of the $\pi^0$ Meson off of the Nucleon. ANTHONY VILLANO, Rensselaer Polytechnic Institute — Nucleon transition amplitudes offer insight into the transition between hadronic degrees of freedom and quark-gluon degrees of freedom. Since many resonant excitations of the nucleon couple strongly to single pion production, one can hope to probe the interesting transition region through pion production measurements. A study of $\pi^0$ production from a nucleon target at $Q^2$ of 6.4 and 7.7 GeV$^2$ has recently been undertaken by the Jefferson Lab Hall C collaboration. The differential cross sections can be used to constrain excitation form factors $G_{\pi N}$ and several multipole transition amplitudes for the lowest lying nucleon excitation, the $\Delta(1232)$ resonance. Differential cross sections as they relate to both non-resonant processes and resonance excitations will be discussed. Information on the excitation form factors and multipole amplitudes will be presented along with the implications of various theoretical predictions.

2:48PM JE.00005 Vector Meson Form Factors and Wave Functions from Holographic QCD. I. HOVHANNES GRIGORYAN, Jefferson Lab/LSU, ANATOLY RADYUSHKIN, Jefferson Lab/ODU — Based on the holographic dual model of QCD, we study 2- and 3-point functions of vector currents and derive form factors as well as wave functions for the vector mesons. As a result, generalized vector-meson dominance representation for form factors is obtained with a very specific VMD pattern. The calculated electric radius of the rho-meson is shown to be in a good agreement with predictions from lattice QCD.

3:00PM JE.00006 Gluelump Spectrum on Coulomb Gauge QCD. PENG GUO, ADAM SZCZEPANIak, Physics Department and Nuclear Theory Center, Indiana University, Bloomington, IN 47405, USA, ANDREA VASSALLO, GIUSEPPE GALATA, ELENA SANTOPINTO, I.N.F.N. and Dipartimento di Fisica, via Dodecaneso 33, Genova, I-16146, Italy — We compute the energy spectrum of low-lying gluonic excitations in the presence of static quark-antiquark octet color sources at zero separation using Coulomb gauge and the quasi-particle representation. The states also refer to gluelump states. We will show how many-body interactions from non-abelian Coulomb kernel generate correct ordering of spectrum for spin-parity-change conjugation multiplets.

3:12PM JE.00007 A New Picture of Structure of Meson. BING AN LI, Dept. of Phys., Univ. of Kentucky — Quark model and parton model are the two models of hadrons. In this talk a unified model of meson structure is presented. Based on current algebra and chiral symmetry a chiral field theory of pseudoscalar, vector, axial-vector mesons is constructed. Besides three current quark masses there are two parameters. The theory is phenomenologically successful. A brief review of the achievements is presented. In this talk we emphasize the new picture of structure of pion. $m_\pi^2$ is derived. Pion form factor is predicted, which is in excellent agreement with data in both space-like and time-like regions. A new asymptotic pion form factor $F(Q^2) \sim Q^2$ at $Q^2 \rightarrow \infty$ is obtained. The pion structure is revealed:

1. when $q^2 < m_\pi^2$ pion is made of a pair of constituent quarks: $qq$
2. when $q^2 > m_\pi^2$ pion is made of a pair of constituent quarks plus $\rho$ cloud multi-quark pairs
3. at large $q^2$ pion is made of a pair of constituent quarks plus a hard gluon

Similar structures for kaons and other mesons are presented.

3:24PM JE.00008 Fermilab E906: Extension to High-X of Measurement of the Anti-quark Distributions of Nuclei and Nucleons. DONALD ISENHOWER, Abilene Christian University, FERMILAB E906 COLLABORATION — The quark-level structure of the nucleus has been studied by various methods. Fixed-target Drell-Yan scattering can kinematically select events that specifically probe the target’s antiquark distributions and is ideally suited to study these effects. Fermilab E906, which was approved by Fermilab in 1999, after the completion of Fermilab E866/NUSea in 1997, has recently been given permission to proceed with construction of the experiment. E866/NUSea yielded a number of important physics results, including total proton-proton cross sections, energy loss measurements, and the first measurement of the cross section ratio of proton-proton to proton-deuteron collisions over a large kinematic range, allowing the extraction of the ratio of anti-down to anti-up quarks in the proton. E906 will take advantage of the lower energy of the Fermilab Main Injector to extend the range of the E866/NUSea measurements to larger Bjorken-$x$ to further the search for changes in the sea quark distributions in nuclei. The apparatus to be used will be discussed, along with the many studies for optimizing the experiment.

1Supported in part by the U.S. Department of Energy
3:36PM JE.00009 Quark Model of Heavy Baryons , MUSLEMA PERVIN, Physics Division, Argonne National Laboratory, WINSTON ROBERTS, Physics Department, Florida State University — We use a nonrelativistic quark model to examine the spectrum of heavy baryons. The model provides a good description of the known states in the heavy \( \Lambda_Q, \Sigma_Q \) and \( \Omega_Q \) spectra, and it successfully predicts, without fitting, a number of states recently seen. When applied to the heavy cascade (\( \Sigma_Q \)) spectrum, the model can be used to determine the sixtet-antitriplet mixing in the known states. We briefly discuss some aspects of this mixing. This work is supported by the U. S. Department of Energy, Office of Nuclear Physics, under contract No. DE-AC02-06CH11357.

3:48PM JE.00010 Search for \( \Phi(1862) \) Pentaquark States with CLAS , HOVANES EGIYAN, University of New Hampshire, CLAS COLLABORATION — Following the first observations of the possible \( S = \pm 1 \) pentaquark state \( \Phi^+(1540) \), there have been many experiments in various laboratories to confirm these results and to search for states which could be associated with other members of the pentaquark antidecuplet. The NA49 collaboration reported the observation of narrow \( S = -2 \) states with masses about 1860 GeV showing in the \( \Xi^- \) invariant mass spectra. These states were identified as isospin 3/2 members of the pentaquark antidecuplet, and were named \( \Phi(1862) \). However, other experiments have failed to reproduce these results. A new experiment has recently been performed at Jefferson Lab using the CLAS detector to search for the \( \Phi(1862) \) state in photoproduction on a deuteron target. A large amount of data has been collected and analyzed, and approximately two thousand \( \pi^- \Xi^- \) events were identified. The preliminary invariant mass spectrum of the \( \pi^- \Xi^- \) system, where the \( \Phi^{-}(1862) \) pentaquark state is expected, will be presented and discussed.

4:00PM JE.00011 Precision fragmentation function measurements at Belle , MARTIN LEITGAB, UIUC, BELLE COLLABORATION — In order to precisely measure the gluon polarization in inclusive hadron production at RHIC and in semi-inclusive DIS good knowledge of the unpolarized fragmentations is necessary. As most of the world data on fragmentation functions has been obtained at LEP energies, especially the gluon fragmentation function is poorly known. The Belle experiment at KEKB in Japan has a large amount of data from which fragmentation functions can be extracted at relatively low scale with high precision. In addition also spin dependent fragmentation functions, such as the Collins function and the interference fragmentation function can and partially have been obtained from this data. Those fragmentation functions are important to extract the transverse quark spin polarization at RHIC and in semi-inclusive DIS. The current status of the analysis will be presented.

Saturday, October 13, 2007 2:00PM - 4:48PM – Session JF Neutrino Physics Newport News Marriott at City Center Pearl Salon II

2:00PM JE.00001 Neutrino Oscillation Results from the MiniBooNE Experiment , GEOFFREY MILLS, Los Alamos National Laboratory, MINIBOONE COLLABORATION — The MiniBooNE neutrino oscillation experiment has been recording neutrino data since September 1, 2002, and anti-neutrino data since February, 2006, at the Fermi National Accelerator Laboratory. This paper will review the status of the MiniBooNE experimental program and present the most recent oscillation results.

2:12PM JE.00002 Investigating Neutrino Interactions with MiniBooNE , REX TAYLOE, Indiana University, MINIBOONE COLLABORATION — The MiniBooNE experiment at Fermilab has collected the world’s largest sample of neutrino scattering events in the 1 GeV energy region. This sample includes both charged-current and neutral-current scattering events in quasielastic and resonant channels. These events are providing new insight about neutrino interactions on light nuclei (carbon). Results and interpretations from the neutrino data set will be presented. Initial results from recent antineutrino running will also be discussed.

2:24PM JE.00003 Charged-Current Interaction Measurements in MiniBooNE , TEPEPEI KATORI, Indiana University, MINIBOONE COLLABORATION — Low energy \( 200 < \nu_{\mu} < 2000 \) MeV neutrino oscillation experiments, including MiniBooNE, require a model of charged current quasi-elastic (CCQE) neutrino interactions to predict signal samples. Using a high-statistics sample of muon neutrino CCQE events, MiniBooNE finds that a simple Fermi gas model, with appropriate adjustments, accurately characterizes the CCQE events observed in a carbon-based detector. The extracted parameters include an effective axial mass, \( m_A = 1.23 /+/- 0.20 \) GeV, used to describe the four-momentum dependence of the axial-vector form factor of the nucleon and a Pauli-suppression parameter, kappa = 1.019 /+/- 0.011.

2:36PM JE.00004 MINERvA: A High Precision Neutrino-Nucleus Scattering Experiment at Fermilab , ROBERT BRADFORD, University of Rochester, MINERVA COLLABORATION — The MINERvA experiment is a high-precision neutrino scattering experiment designed to improve our understanding of the basic neutrino-nucleus interaction. Currently under construction, the detector will employ fine grained scintillator to achieve good vertex and timing resolution as well as full event reconstruction. Once deployed in the MINOS Near Detector Hall of the NuMI Beamline at Fermilab, the experiment will collect an estimated 14.5 M charged-current neutrino interactions on a variety of nuclear targets (H3, C, Fe, Pb) over a planned four year run. A diverse physics program includes measurements of total and differential cross sections for a number scattering topologies, studies of the axial structure of the nucleon, and studies of nuclear effects in neutrino scattering.

2:48PM JE.00005 Measuring Nuclear Effects on Neutrino-Nucleus Interactions with MINERvA , JORGE MORFIN, Fermilab, MINERVA COLLABORATION — Nuclear effects on neutron induced interactions are expected to be different than those observed in charged lepton - nucleus experiments. A summary of these expected differences, an overview of the Kulagin-Petti model for neutrino-nucleus interactions and a description of the MINERvA measurement of nuclear effects will be presented.

3:00PM JE.00006 Observation of Muon Neutrino Disappearance with the MINOS Detectors in the NuMI Neutrino Beam¹, PATRICIA VAHLE, University College London, MINOS COLLABORATION — The Main Injector Neutrino Oscillation Search (MINOS) is a long baseline neutrino oscillation experiment that uses a muon-neutrino beam produced by the Neutrinos at the Main Injector (NuMI) facility at Fermi National Accelerator Laboratory (FNAL). The experiment is conducted with a pair of functionally identical detectors, located at two sites, the Near Detector (ND) at FNAL and the Far Detector (FD) in the Soudan Underground Laboratory in Minnesota. The NuMI beamline and the 735 km long-baseline allow a search for \( \nu_\mu \) disappearance, a rigorous test of the oscillation hypothesis, and a measurement of the \( \Delta m_{23}^2 \) and \( \sin^2(\theta_{23}) \) mixing parameters studied previously with atmospheric neutrinos and by the K2K experiment. I will describe the MINOS experiment and discuss highlights from the second year of beam data-taking before presenting a measurement of \( \Delta m_{23}^2 \) and \( \sin^2(\theta_{23}) \) based on an exposure of \( 2.5 \times 10^{20} \) POT (protons on target). I will conclude with a discussion of the experiment’s future prospects, including a search for sub-dominant \( \nu_\mu \rightarrow \nu_e \) transitions.

¹For the MINOS Collaboration
3:12PM JF.00007 The Daya Bay Reactor Electron Anti-neutrino Oscillation Experiment

JIANGLAI LIU, California Institute of Technology, DAYA BAY COLLABORATION — The phenomenon of neutrino flavor oscillations is now well-established. Mixing among the three flavors is characterized by three mixing angles, with $\theta_{13}$ being the only presently unknown angle. A precise measurement of $\theta_{13}$ using nuclear reactors as a source of electron anti-neutrinos requires high electron anti-neutrino flux, $\sim 2$ km baselines, as well as good shielding to reduce cosmogenic backgrounds. The Daya Bay nuclear reactor complex located in south China is an ideal site to perform such a measurement. We have proposed an experiment at Daya Bay utilizing multiple baselines (between 0.3 and 2 km) and multiple liquid scintillator detector modules. Since the formal physics proposal in 2006, much progress has been made by the collaboration in the design of the experiment. The civil construction of the experiment will begin this year. In this talk, I will give an overview of the experiment, and report on the recent progress and the project status.

1Supported in part by DOE grant DE-FG02-97ER41033 (Duke) and NSF grant NSF-PHY-05-52723

3:24PM JF.00008 Measuring the Atmospheric Neutrino Flux at the Sudbury Neutrino Observatory

JOSEPH FORMAGGIO, Massachusetts Institute of Technology, SNO COLLABORATION — The Sudbury Neutrino Observatory consists of a 1 kiloton heavy water Cerenkov detector designed to study the flux of neutrinos created in the solar core. In addition to solar neutrinos, the SNO experiment is also able to study the flux of atmospheric neutrinos by measuring the rate of neutrino induced muons traversing the heavy water volume. Due to the depth and flat overburden of the SNO detector (6010 meters water equivalent), it is possible in principle to determine both the unoscillated and oscillated components of the atmospheric neutrino flux as a function of energy. This talk will describe SNO’s measurement of the atmospheric muon neutrino flux using data from the first phase of the experiment.

3:36PM JF.00009 SNO External Muon System

THOMAS WALKER, Massachusetts Institute of Technology, SNO COLLABORATION — The SNO (Sudbury Neutrino Observatory) muon reconstruction algorithm reconstructs simulated events in good agreement with the track coordinates given by the Monte Carlo generator. However, no source of known muon tracks was previously available for an independent verification. The July 2006 installation of the SNO External Muon System (EMuS) provided a means for external verification of SNO’s tracking algorithm. This tracking detector consists of 4 planes of wire chambers (2 each in the x and y directions) triggered by 3 large scintillator paddles. Each plane contains 32 active wires housed in 7.5 cm diameter tubes. The detector has an active area of 5.5 square meters. In 96 days of livetime 30 cosmic ray muons were recorded by both detectors. Using the SNO reconstruction track for each muon as a seed, the most likely path through EMuS is determined and compared to the standard muon tracking algorithm. We see good agreement between the EMuS and SNO tracks.

3:48PM JF.00010 Partial (n,γ') cross section measurements of Cu, Ge and Pb at 8 and 12 MeV for 0νββ decay

E. KWAN, J.H. ESTERLINE, Duke Univ. and TUNL, S. ELLIOT, LANL, B. FALLIN, Duke Univ. and TUNL, S.H. HILDERBRAND, NCCU, A. HIME, LANL, C.R. HOWELL, A. HUTCHESON, Duke Univ. and TUNL, H.J. KARWOWSKI, UNC and TUNL, J.H. KELLEY, NCSU and TUNL, M.F. KIDD, Duke Univ. and TUNL, D.B. Masters, Sanford Univ., D. MEI, LANL, A.P. TONCHEV, W. TORNOW, Duke Univ. and TUNL — The possible implications of 0νββ decay have sparked efforts into the verification of the existence of such decays. The detection of such a decay in 76Ge would confirm that neutrinos are massive Majorana particles and would produce new physics beyond the Standard Model. Measurements of these reactions require an extensive understanding of the background sources. Understanding the potential for neutron induced excitation in the shielding and detector materials is important for designing future double-beta decay experiments. Gamma transitions at 2041 keV, 2615 keV and 3962 keV either directly interfere with the 0νββ decay detection of 76Ge at 2040 keV or produce escape peaks within this region of interest. Gamma-ray spectra from the interaction of pulsed mono-energetic neutrons with natCu, natGe, and natPb were measured at TUNL using an array of segmented HPGe Clover detectors. From these spectra, the neutron induced partial cross sections for γ transitions in Cu, Ge, and Pb were deduced at Eγ=8 and 12 MeV.

4:00PM JF.00011 Double Beta Decay of 150Nd to Excited Final States

MARY KIDD, JAMES ESTERLINE, WERNER TORNOW, TUNL - Duke University — Studying ββ decay with emission of neutrinos (2νββ) in particular is important as a check for theoretical models which can be used to predict the half-lives of neutrinoless ββ decay (0νββ). Results from studying 2νββ decay can aid in the search for 0νββ decay, which in turn can provide information on the fundamental properties of the neutrino. Because SNO+ and KamLAND plan to use 150Nd as a nuclide in searches for 0νββ decay, our goal is to measure the 2νββ decay of 150Nd to the first excited 0+ state in 150Sm. In QRPA models, the calculated matrix elements for transitions to the ground state and excited states depend in a very different way on the so-called g_{µµ} parameter. Therefore, 2νββ decay data to excited states are of particular interest. Such data exist only for 100Mo; only tentative information is available for 150Nd. Thus, we report on our preliminary studies and our plans for observing the decay of 150Nd to the first excited 0+ state in 150Sm by detecting the 334 keV and 406.5 keV deexcitation gamma rays in coincidence.

4:12PM JF.00012 Detector Characterization for the Majorana Project

ELIZA OSENBAUGH-STEWART, REYCO HENNING, TUNL - UNC, MAJORANA PROJECT COLLABORATION — The Majorana Project aims to measure neutrinoless double-beta decay or definitively rule out significant portions of the allowed neutrino mass space. Neutrinoless double-beta decay is a very rare decay and count rates are expected to be very low, on the order of a few hundred counts per ton year or less. It is therefore crucial that background rates be very low. Detector characterization allows us to optimally utilize Pulse Shape Discrimination to reduce background rates. We present a new method of HPGe detector characterization that will decrease the time required to fully characterize a detector. This is critical to maintain the required production rate for crystals for the Majorana Project. A set of collimated pencil gamma-ray beam data will be compared to a set of simulated pulse shapes and the parameters optimized to create a full characterization scheme without the need for a secondary collimator orthogonal to the beam.

4:24PM JF.00013 Homestake Ultra-Low Background Counting Facility and Detection of Double-Beta Decay to Excited States

DONGMING MEI, The University of South Dakota, KEVIN LESKO, Lawrence Berkeley National Laboratory, CHRISTINA KELLER, YONGCHEN SUN, ZHONGBAO YIN, The University of South Dakota, ROBERT MCTAGGART, South Dakota State University, BARBARA SZCZERBINSKA, Dakota State University, ANDREW ALTON, Augustina College, WILLIAM ROGGENTHEN, South Dakota School Mines & Technology, YUEN-DAT CHAN, AL SMITH, GERSENDE PRIOR, Lawrence Berkeley National Laboratory — A powerful, ultra-low-background counting facility, for material screening is crucial to the success of many deep underground science and engineering laboratory (DUSEL) experiments dealing with extremely rare-occurring processes that are of great scientific importance. In order to reach the ultimate sensitivity necessary for these experiments such as (e.g.) in dark matter searches and nuclear double-beta decay, only materials with the lowest possible radioactivity can be used in fabricating the experimental devices, and the entire setup must be located in a deep underground site. The Homestake Mine, home to the first solar neutrino experiment, provides an excellent opportunity to host DUSEL, as well as the required ultra-low-background laboratory facility. Besides low background counting, detectors in this facility can also be used to perform important physics experiments, such as studying the nuclear double-beta decay to excited-state process, a topic which has recently drawn both strong experimental and theoretical interests. Experimentally, it is a great advantage to be able to detect unambiguously the gamma-rays from the de- excitation of the daughter nucleus to its ground state, as proposed in our method.
discussed in this context.

To investigate this phenomenon, the results of which will be summarized. Excited states at high spins where oblate collective rotation is expected to become
protons and neutrons, have low
confluence of conditions necessary for the realization of oblate collective rotation at high spins. The valence, high-j orbitals near the Fermi surface, for both
K
= 0,2 states in

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Lu, TSD bands in the mass
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region have received considerable attention. Previously, three TSD bands were

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Lu, TSD bands in
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Dy

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and 2 excitations are similar in energy. To further investigate this behavior, an experiment was performed to measure intensities

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The work was supported by USDOE Grant No. DE-FG02-91ER-40699 and DE-FG52-06NA26206

2
12PM JG.00001 Investigation of

152,153
Dy

1
, BABAK SHORAKA, Yale University/University of Surrey, VOLKER WERNER, ELIZABETH MCCUTCCHAN, HO-CHIANG AI, ROBERT J. CASPERSON, RICK CASTEN, ANDREAS HEINZ, Yale University, BERNHARD HUBER, Yale University/University of Heidelberg, ROBERT LUETTKE, Yale University/TU Darmstadt, JING QIAN, RUSS TERRY, ELIZABETH WILLIAMS, RYAN WINKLER, Yale University — 152Dy is one of the most studied nuclei in the nuclear chart. Excited states in 152Dy (and 153Dy) were populated via the 124Sn(33S,Xn) reaction with the beam being delivered by the ESTU tandem accelerator at the Wright Nuclear Structure Laboratory. The New Yale Plunger Device (NYPD) was used in the SPEEDY array. Lifetimes are determined using the differential decay curve method from gamma-gamma coincidence data. First results will be presented.

2
This work was supported by USDOE Grant No. DE-FG02-91ER-40699 and DE-FG52-06NA26206

2
24PM JG.00002 Triaxial Strongly Deformed bands in

163
Tm

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130
Te(37Cl,4n)

using Gammasphere at BNFL and at ANL, respectively. It has been confirmed that the two new bands in
163
Tm, interpreted as TSD bands based on particle-hole excitations, are associated with a larger deformation than the yrast sequences. The measured quadrupole transition moments will be compared with those of neighboring nuclei. Further, TAC calculations will be presented. They provide a natural explanation for the presence of wobbling bands in the Lu isotopes and the absence of such bands in all neighboring Tm, Hf and Ta nuclei.

2
This work has been supported in part by the U.S. Department of Energy, Office of Nuclear Physics, under contract No. DE-AC02-06CH11357, the U.S. National Science Foundation, and the Department of Science and Technology, Government of India.

2
24PM JG.00003 The Decay Pathways of a Triaxial Strongly Deformed (TSD) Band in

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Hf

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Lu, TSD bands in the mass
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region have received considerable attention. Previously, three TSD bands were reported in
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Hf which is the first evidence for triaxial superdeformation in an even proton system [1]. However, none of the bands was linked to known levels. Consequently, the spin,parity, excitation energy, and intrinsic configurations of the bands remain unknown. Recently, we further analysed the
γ
-ray coincidence data obtained from the Gammasphere experiment at ANL using a self-supporting target. The decay pathways of TSD2 band to low-spin normal deformed states is presented. These cross-sections will allow us to evaluate the expected neutron-induced background for CUORE. This work was performed under the auspices of the U.S. Department of Energy by University of California, Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

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now at University of Guelp, Ontario, Canada

Saturday, October 13, 2007 2:00PM - 4:36PM
Session JG Nuclear Structure IV
Newport News Marriott at City Center Pearl Salon III

4:36PM JF.00014 Neutron-induced background studies for CUORE, M.J. DOLINSKI, P.E. GARRETT1, E.B. NORMAN, W. YOUNES, Lawrence Livermore National Laboratory, M. DEVLIN, N. FOTIADES, R.O. NELSON, Los Alamos National Laboratory — CUORE (Cryogenic Underground Observatory for Rare Events) is a bolometric next generation neutrinoless double beta decay experiment. It will be sited at the Laboratori Nazionali del Gran Sasso (LNGS) in Italy, with a rock overburden of \sim
3300 m.w.e. In order for CUORE to reach its projected five year half-life sensitivity of \sim
2.1 \times 10^{26} yr, the background in the region of interest must be lower than 0.01 counts/keV/kg/yr. One potential source of background is inelastic scattering of neutrons on the naturally abundant isotopes of Te, which make up 80% of the TeO2 bolometers' absorber mass. Using the GANLIKE HPGe detector array at Los Alamos Neutron Science Center (LANSCE), we have measured the gamma production cross-sections for neutron interactions on an unenriched Te target. These cross-sections will allow us to evaluate the expected neutron-induced background for CUORE. This work was performed under the auspices of the U.S. Department of Energy by University of California, Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

1
Supported by USDOE Grant DE-FG02-94ER40848
3:00PM JG.00006 Insights into Nuclear Triaxiality from Interference Effects in E2 Matrix Elements1. J.M. ALLMOND, J.L. WOOD, W.D. KULP, Georgia Institute of Technology — Recently, we have introduced [1] a triaxial rotor model with independent inertia and E2 tensors. The E2 matrix elements [2] of the osmium isotopes (186, 188, 190, and 192) are studied in the framework of this model (59 of 84 E2 matrix elements deviate by 30% or less). It is shown that interference effects in the inertia tensor (K-mixing) and the E2 tensor can lead to significant reductions in the diagonal E2 matrix elements. In some instances, the diagonal E2 matrix elements may decrease with increasing spin. Additionally, a sum rule for diagonal E2 matrix elements is shown and used to explore missing strength from K-admixtures.

1 Supported by the U.S. DOE (Grants DE-FG02-88ER40406 and DE-A02-06CH11357).

3:12PM JG.00007 Structure of the 43+ States in 186,188Os. A.A. PHILLIPS, P.E. GARRETT, G.A. DEMAND, P. FINLAY, K.L. GREEN, K.G. LEACH, M.A. SCHUMAKER, C.E. SVENSSON, J. WONG, University of Guelph, R. HERTENBERGER, Ludwig-Maximilians-Universitat Munich, T. FAESTERMANN, R. KRUCKEN, H.-F. WIRTH, Technische Universitat Munchen, L. BETTERMANN, N. BRAUN, Universitat zu Koeln, D.G. BURKE, McMaster University — The structures of 43+ states in the Os nuclei have been the subject of debate for the past several decades. Based on measured B(E2) values, they were interpreted in 186,190Os as K−4=43/2− two-phonon γ vibrations, whereas inelastic scattering results, and single-proton transfer (d, 3He) and (t, α) reactions imply a hexadecapole phonon description. Uncertainties in the (t, α) reaction mechanism, however, were cited as preventing a firm conclusion based on those data. To help clarify the nature of these K−4=43/2− bands, we have performed a (He3,d) stripping reaction on targets of 185,187Re using 30 MeV He beams provided by the MP-tandem facility of the LMU/TUM in Garching. With an energy resolution of 13 keV, the deuterons were analyzed at 9 angles ranging from 5° to 50° with the Q3D spectrograph, and absolute cross sections were obtained for levels up to 3 MeV in excitation energy. Preliminary results will be presented.

3:24PM JG.00008 Detailed spectroscopy of 219Th1. W. REVIOL, D.G. SARANTITES, C.J. CHIARA, O.L. PECHEYANA, M. MONTERO, Washington University, M.P. CARPENTER, R.V.F. JANSSENS, T.L. KHOO, T. LAURITSEN, C.J. LISTER, D. SEWERYNIAK, S. ZHU, Argonne National Laboratory — The previously unexplored nucleus 219Th has been studied, using the 109Pb(20Mg,5n) Eα=128 MeV (ATLAS) fusion-evaporation reaction and the Gammasphere + HERCULES detector combination. The level scheme constructed from evaporation-residue selected γ-ray coincidence data has the following features: The ground state E2 sequence [neutron (60/2−)] shows a vibrational-like behavior. Another positive-parity E2 sequence is present and concurs with the picture of weak coupling of an h11/2 neutron to the 116Th core. Among the set of negative-parity states is a short E2 sequence that forms, together with the h11/2 sequence, an octupole-type band. The discussion will focus on the latter band structure. A trend for parity doublets in odd-mass Th nuclei will be presented.

1 Supported by the U.S. DOE (Grants DE-FG02-88ER40406 and DE-A02-06CH11357).

3:36PM JG.00009 ABSTRACT WITHDRAWN

4:00PM JG.00011 Technique for Angular Correlations and g-factor Measurements in Nuclei Produced in the Spontaneous Fission of 252Cf. C. GOODIN, A.V. DANIEL, K. LI, A.V. RAMAYYA, N.J. STONE, J.K. HWANG, J.H. HAMILTON, J.R. STONE, Y.X. LUO, J.O. RASMUSSEN, M.A. STOYER, S.J. ZHU, G.M. TER-AKOPIAN, I.Y. LEE — We present a new technique for measuring angular correlations between γ-rays emitted by the fragments from the spontaneous fission of 252Cf and measured with Gammasphere. For states with short lifetimes (<10ps), these correlations can be used to determine the spin and parity of unknown levels. For states with long lifetimes, the technique can be used to determine the g-factor of the level in question by measuring the attenuation of the correlation caused by rotation of the nucleus about the randomly oriented domains in an un-magnetized iron foil. Applying our new method to our set of triple coincidence data collected from the fission of 252Cf, we have been able to verify the spins of new levels in 138Cs, as well as new levels in 108,110,112Ru. We have also been able to reproduce the results of known g-factors for several nuclei, and the extremely high statistics (~10^11 events) of our data set will allow us to measure unknown g-factors of other excited states. Calculation of the relative detector efficiencies and the solid angle correction factor will be used as well as the procedures for the angular binning, peak fitting, and background subtraction.

4:12PM JG.00012 K isotopes in Cm isotopes via deep-inelastic and transfer reactions1. U.S. TANDEL, P. CHOWDHURY, S.K. TANDEL, A.J. KNOX, C.M. WILSON, University of Massachusetts Lowell, I. AHMAD, M.P. CARPENTER, J.P. GREENE, S. GROS, R.V.F. JANSSENS, T.L. KHOO, F.G. KONDEV, T. LAURITSEN, C.J. LISTER, D. PETERSON, A. ROBINSON, D. SEWERYNIAK, X. WANG, S. ZHU, Argonne National Laboratory — K isotopes in 240Cm and 248Cm (Z = 96) were populated via deep-inelastic and transfer reactions using a 209Bi beam at ~15% above the Coulomb barrier, incident on a long-lived 240Cm target. This reaction mechanism has been employed for the first time in trans-plutonium nuclei to study high-K isotopes. The out-of-beam data were collected using Gammasphere in different time regimes ranging from 80 microseconds up to 8 seconds to adjust to different isotope half-lives. The half-life of a known 8+ isomeric state in 246Cm has been measured to be ~1 s. A new high-K isomer with K+ = 8− has also been discovered in 248Cm. These K+ = 8− isomers have the same underlying neutron [624]/7/2 x [734]/9/2 configuration as is observed in the isotones 250Fm and 252No. These new data on high-K isotopes will add to the limited knowledge of single-particle and pair-gap energies in heavy actinides.

1 Supported by USDOE Grants DE-FG02-94ER40848 and W-31-109-ENG-38.
Radioactive Decay Energy Reactions Should Include Vibrational and Rotational Kinetic Energies

STEWARD BREKKE, Northeastern Illinois University (frmr grad student) — In order to reconcile theory with experimental results energy relations of unstable nuclei should include vibrational and rotational kinetic energies. For alpha decay: \( M_{p\alpha}c^2 + 1/2\omega_\alpha^2 + (n+1/2)\hbar\omega + 1/2M_{p\alpha}c^2 = M_{p\alpha}c^2 + 1/2\omega_\alpha^2 + (n+1/2)\hbar\omega + 1/2M_{p\alpha}c^2 + 1/2\omega_\alpha^2 + (n+1/2)\hbar\omega + 1/2M_{p\alpha}c^2 + 1/2\omega_\alpha^2 + (n+1/2)\hbar\omega + 1/2M_{p\alpha}c^2 \). For beta decay: \( M_{\beta}c^2 + 1/2\omega_\beta^2 + (n+1/2)\hbar\omega + 1/2M_{\beta}c^2 = M_{\beta}c^2 + 1/2\omega_\beta^2 + (n+1/2)\hbar\omega + 1/2M_{\beta}c^2 + 1/2\omega_\beta^2 + (n+1/2)\hbar\omega + 1/2M_{\beta}c^2 \). 1/2\omega_\alpha is the rotational kinetic energy and \((n+1/2)\hbar\omega_\alpha\) is the vibrational kinetic energy.

**Saturday, October 13, 2007 2:00PM - 4:00PM**

Session JH Light Ions and Inverse Reactions

Newport News Marriott at City Center Blue Point I

2:00PM JH.00001 Direct Measurement of the \( S_0 \) Neutron-Neutron Scattering Length at the YAGUAR Reactor


All significant components with a given angular momentum were identified, then sum rules were used to obtain occupation numbers in a consistent manner.

Adding and removing transfer reactions were measured at the Yale ESTU tandem, with careful attention to absolute, and especially relative, cross sections.

Measurements were made at around thirty angles for each energy using neutron source reactions, with polarizations ranging from 0.3 to 0.5. The data, recently corrected for finite geometry and multiple scattering effects, are compared to earlier experimental results as well as new \textit{ab initio} calculations, as presented.

2:12PM JH.00002 A study of proton-deuteron scattering in configuration space

VLADIMIR SUSLOV, MIKHAIL BRAUN, IGOR FILIKHIN, BRANISLAV VLAHOVIC, North Carolina Central University, Durham, NC 27707 USA — A new computational method for solving the configuration-space Faddeev equations for the breakup scattering problem [1] has been applied to consider the pd scattering below and above the deuteron threshold. To perform numerical calculations for arbitrary nuclear potential and with arbitrary number of partial waves retained we use approach proposed in [2]. The calculations of the inelasticity and phase-shift for various lab energies were performed with the charge independent AV14 potential. The results are compared with those of other authors [3, 4].


2:24PM JH.00003 Neutron-Helium 3 Analyzing Powers between 1.60 and 5.54 MeV

JH. ESTERLINE, A.S. CROWELL, B.A. FALLIN, C.R. HOWELL, A. HUTCHESON, M.F. KIDD, M.R. KISER, R.A. MACRI, S. TAJIMA, W. TORNOW, TUNL & Duke University, B.J. CROWE, N.C. Central University & TUNL, R.S. PEDRONI, N.C. A&T University & TUNL, G.J. WEISEL, Penn State Altoona & TUNL — As part of a broader investigation of the four-nucleon system, the analyzing power for neutron-helium-3 scattering was measured at Triangle Universities Nuclear Laboratory (TUNL) at five neutron energies between 1.60 and 5.54 MeV. Measurements were made at around thirty angles for each energy using neutron beams, produced by the \( T(p,n)\)He and \( D(d,n)\)He source reactions, with polarizations ranging from 0.3 to 0.5. The data, recently corrected for finite geometry and multiple scattering effects, are compared to earlier experimental results as well as new \textit{ab initio} calculations, as presented.

This work has been supported by ISTC project 2286, US DOE grant numbers DE-FG02-97-ER41042 and DE-FG02-97-ER41033 and the US NSF through an International Research Fellow Award number 0107263 and grant number 0555652.

2:36PM JH.00004 Ab \textit{ab initio} no-core shell model and microscopic light-ion reactions

SOFIA QUAGLIONI, PETR NAVRATIL, LLNL — We report on recent results of our work in the direction of building an \textit{ab initio} method for low-energy light-ion reactions by augmenting the no-core shell model (NCSM)\textsuperscript{1,2} to include clustering and resonant and non-resonant continuum. For this purpose, we adapt the resonating group method\textsuperscript{3}, a microscopic technique in which the many-body problem is mapped onto various channels of nucleon clusters and their relative motion. In our approach we use NCSM wave functions for the clusters involved, and NCSM effective interactions derived from realistic nucleon-nucleon and three-nucleon interactions. In particular, we will present our first results for the scattering of low-energy neutrons on \( ^4\text{He} \).


2:48PM JH.00005 Nuclear Structure Measurements for \( (0\nu2\beta) \) Decay of \(^{76}\text{Ge} \)

J.P. SCHIFFER, Argonne National Laboratory, S.J. FREEMAN, University of Manchester, A.C.C. VILLARI, GANIL, Caen, J.A. CLARK, C. DEIBEL, Yale University, S. GROS, Argonne National Laboratory, C.R. FITZPATRICK, University of Manchester, A. HEINZ, Yale University, D. HIRATA, GANIL, Caen, C.L. JIANG, Argonne National Laboratory, B.P. KAY, University of Manchester, A. PARIKH, P.D. PARKER, J. QIAN, Yale University, K.E. REHM, X.D. TANG, Argonne National Laboratory, W. VERNER, C. WREDIE, Yale University — There are considerable uncertainties in the theoretical matrix elements for neutrinoless double beta decay. To narrow down the possibilities, we have measured the occupation of valence orbitals, with particular attention to the differences between \( ^{76}\text{Ge} \) and \(^{76}\text{Se} \). Neutron adding and removing transfer reactions were measured at the Yale ESTU tandem, with careful attention to absolute, and especially relative, cross sections. All significant components with a given angular momentum were identified, then sum rules were used to obtain occupation numbers in a consistent manner.

Our results indicate that the Fermi surface is considerably more diffuse than those in QRPA used to calculate the \( 0\nu2\beta \) matrix elements. The differences in neutron occupations appear to be spread over many orbits.

This work was supported in part by the U.S. Department of Energy, Office of Nuclear Physics, under Contracts No. DE-AC02-06CH1135 and DE-FG02-91ER-40609.
3:00PM JH.00006 Updates for Gadolinium neutron capture measurements at DANCE, DUGERSUREN DASHDORJ, G.E. MITCHELL, B. BARAMSAI, R. CHANKOVA, A. CHYZH, C. WALKER, North Carolina State University/TUNL, U. AGVAANLUVSAN, J.A. BECKER, W. PARKER, C.Y. WU, Lawrence Livermore National Laboratory, T. BREDEWEG, A. COUTURE, R. HAIGHT, M. JANDEL, J. O’DONNELL, R. RUNDBERG, J. WOUTERS, J. ULLMANN, D. VIEIRA, Los Alamos National Laboratory, F. BECVAR, M. KRTICKA, Charles Univ. Prague — Neutron capture reactions for several isotopes of Gadolinium have been measured at DANCE array in Los Alamos Neutron Science Center. Progress on the analysis is discussed. The detector response function of DANCE array is presented in connection with the statistical gamma-ray decay cascade simulation. In the region of separated neutron resonances, the statistical gamma-ray decay cascade is simulated using the DICEBOX code. Various models for the photon strength function and level density are used as input. The output of simulations is compared with DANCE data.

3:12PM JH.00007 $^{241}$Am(n,$\gamma$) absolute cross sections measured with DANCE, M. JANDEL, T.A. BREDEWEG, M.M. FOWLER, E.M. BOND, M.B. CHADWICK, R.R. CLEMENT, A. COUTURE, J.M. O’DONNELL, R. REIFARTH, R.S. RUNDBERG, J.L. ULLMANN, D.J. VIEIRA, J.B. WILHELMY, J.M. WOUTERS, Los Alamos National Laboratory, Los Alamos, NM, 87545, USA, U. AGVAANLUVSAN, R.A. MACRI, S.A. SHEETS, C.Y. WU, J.A. BECKER, Lawrence Livermore National Laboratory, Livermore, CA, 94550, USA — $^{241}$Am is present in plutonium due to the beta decay of $^{241}$Pu ($t_{1/2}$=14.38 years). As such $^{241}$Am can be used as a detector for nuclear forensics. A precise measurement of $^{241}$Am(n,$\gamma$) cross section is thus needed for this application. The measurement is also of interest for advanced reactor design as part of the Global Nuclear Energy Partnership (GNEP). The Detector for Advanced Neutron Capture Experiments (DANCE) at Los Alamos National Laboratory (LANL) was used for neutron capture cross section measurement on $^{241}$Am. The high granularity of DANCE (160 BaF$_2$ detectors in a 4$\times$4 geometry) enables the efficient detection of prompt gamma-rays following a neutron capture. DANCE is located on the 20.26 m neutron flight path 14(FP14) at the Manuel Lujan Jr. Neutron Scattering Center at the Los Alamos Neutron Science Center (LANSC). The absolute $^{241}$Am(n,$\gamma$) cross sections were obtained in the range of neutron energies from 0.02 eV to 320 keV. The results will be compared to existing evaluations in detail.

3:24PM JH.00008 Benchmarking a surrogate reaction for neutron capture using $^{171,173}$Yb(d,p$\gamma$), R. HATARIK, J.A. CIZEWSKI, P.D. O’MALLEY, T. SWAN, Rutgers University, L.A. BERNSTEIN, J.T. BURKE, Lawrence Livermore National Laboratory, J. GIBELIN, L. PHAIR, Lawrence Berkeley National Laboratory, — The surrogate reaction technique is an indirect way to determine cross sections by measuring a reaction that proceeds through the same compound nucleus. A neutron transfer reaction, such as (d,p) has the advantage over a direct (n,$\gamma$) measurement since it can be measured in inverse kinematics. To test the feasibility of using a (d,p$\gamma$) reaction as a surrogate for neutron capture, a benchmark experiment has been carried out with the goal to reproduce the known [1] neutron capture cross section ratio of $^{171}$Yb and $^{172}$Yb. The $^{171,173}$Yb(d,p$\gamma$) reactions were measured using an 18.5 MeV deuteron beam from the 88-Inch Cyclotron at LBNL. The reaction protons were measured using the Si detector array STARS and coincident $\gamma$-rays were detected using 6 Ge Clover detectors (LiBerACE). Preliminary results comparing surrogate ratio with the measured (n,$\gamma$) cross section will be presented. [1] K. Wisshak et al, Phys. Rev. C 61, (2000) 065801.

3:36PM JH.00009 Photodisintegration Cross Section Measurements for $^{142}$Nd and $^{150}$Nd and Low-energy E1 $\gamma$-ray Strength Functions, C.T. ANGELL, UNC/TUNL, H. UTSUNOMIYA, S. GOKO, A. MAKINAGA, T. KAIHORI, Konan U., H. TOYOKAWA, AIST, Y.W. LUI, Texas A&M — The photo-neutron disintegration cross sections were measured near threshold for $^{142}$Nd, and, for the first time, $^{150}$Nd. The measurements were made using the monoenergetic $\gamma$-ray beam at the AIST Teras facility in Tsukuba, Japan. The $\gamma$-ray beam was produced via laser inverse-Compton scattering. The neutrons were detected using a composite detector consisting of $^3$He proportional counters embedded in a polyethylene block. The technique and facility will be overviewed, highlighting the advantages of a monoenergetic $\gamma$-ray beam to absolute cross section measurements. The results will be compared to theoretical calculations using the Quasi-particle Random Phase Approximation (QRPA). Finally, the neutron number dependence of the low-energy $E1\gamma$ strength function will be discussed.

3:48PM JH.00010 Is ALPHA the Odometer of the Universe?, SHANTILAL GORADIA, Gravity Research Institute, Inc. — The answer seems to be affirmative. ALPHA may be an odometer with sixty decimal points, the last digit moving up one integer every Planck time, displaying the information of the age of the universe. We can only measure it to the ninth decimal point. ALPHA is greater than or equal to the reciprocal of the natural logarithm of the age of the universe in Planck times, sixty orders of magnitude. Eddington spent good portion of his life trying to come up with a value of ALPHA based on multiplicity. Gamow had the insight about the four nucleotides of genetic tape. His deeper 1967 insight was a link between ALPHA and cosmology. Evolution mandates variation of ALPHA. In terms of the entropy equation on Boltzmann’s tomb, ALPHA seems to be the Maxwell’s demon, decreasing the entropy of invisible compartments within which electromagnetic interactions take place. Nature potentially knows only the Planck units. I will discuss the implications for the second law of thermodynamics drafted in physics/0210040 v3.