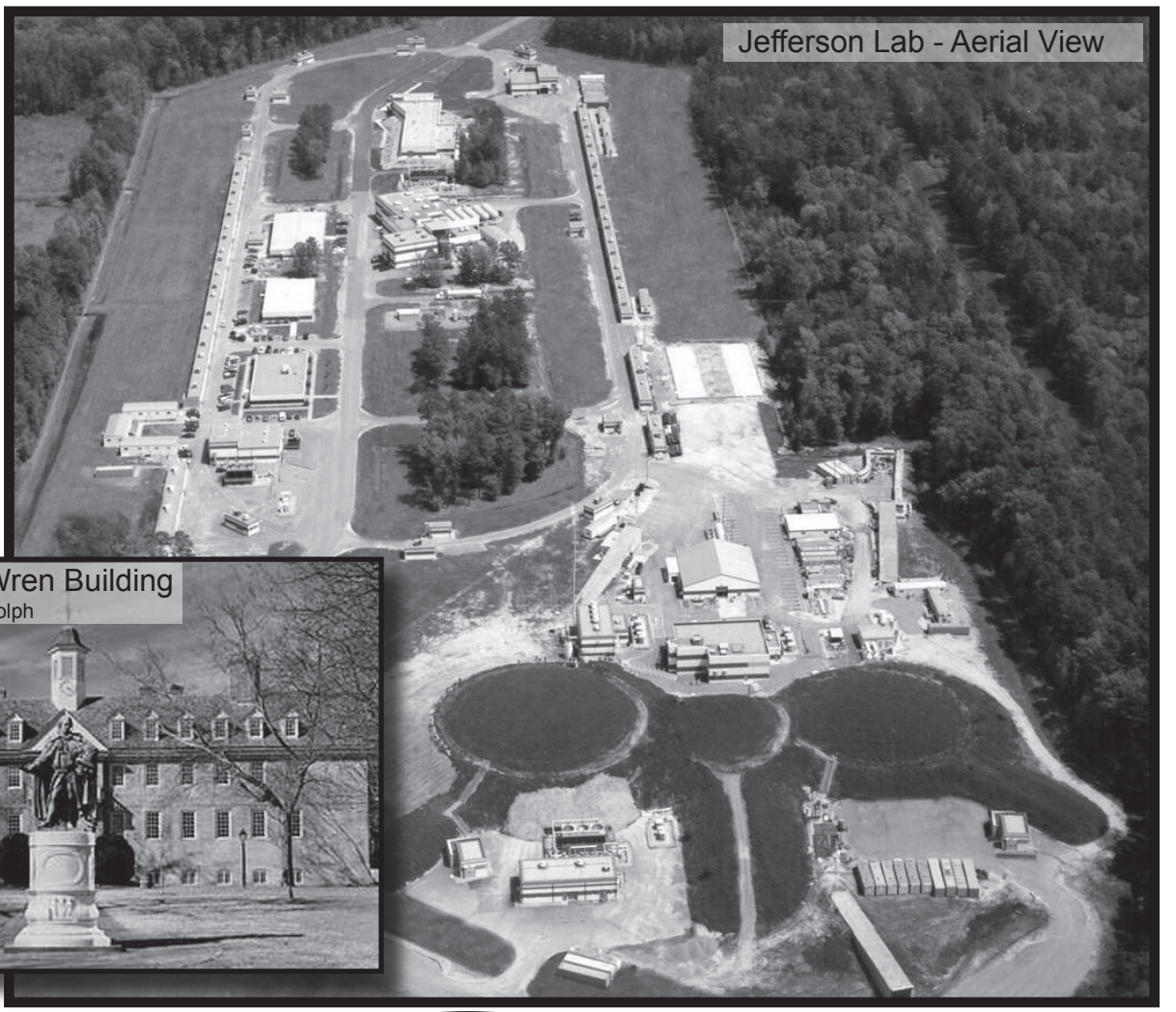
BULLETIN

of the American Physical Society

73rd Annual Meeting of the Southeastern Section of the APS
Thursday - Saturday, November 9 - 11, 2006
Williamsburg, Virginia



SESAPS 2006

November 2006
Volume 51, No. 8

APS physics

Sessions Directory

On the cover: *The two photos depict scenes from our two host institutions for SESAPS06. The Sir Christopher Wren Building on The College of William and Mary campus is the oldest academic building in continuous use in the United States. It was constructed between 1695 and 1699, before Williamsburg was founded and when the capital of the colony of Virginia was still located nearby at Jamestown.*

The aerial photograph of the CEBAF accelerator site at The Thomas Jefferson Laboratory shows clearly the racetrack shape of the underground accelerating ring (560 meters along its long axis), and at the bottom of the photo three circular, green grassy mounds above the three underground experimental halls.

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Preamble of the 73rd Annual Southeastern Section Meeting of the APS
SESAPS 2006
November 9-11, 2006
Williamsburg, Virginia

General Information
The 73rd Annual Meeting of the Southeastern Section of the American Physical Society will be held November 9-11, 2006 (Thursday-Saturday) at the Williamsburg Hospitality House in Williamsburg, Virginia. It will be co-hosted there by The College of William & Mary and the Thomas Jefferson National Accelerator Facility. Detailed, up-to-date information about the meeting can be found at http://conferences.jlab.org/SESAPS/index.html. Williamsburg and the surrounding Tidewater Virginia area are the location of noted sites of historical and tourist interest. Information about these attractions can be found on the meeting hotel website or from the Williamsburg Chamber of Commerce.

Scientific Program
A stimulating program of invited and contributed talks on forefront research topics is outlined by abstracts on the following pages of this Bulletin. Invited talk program highlights are:

Astrophysics - One of the most advanced US physics laboratories is the Laser Interferometer Gravitational Wave Observatory (LIGO), which has one of its two detectors in Livingston, LA. Talks on Thursday afternoon will highlight the status of the search for gravitational waves with LIGO, the astrophysics questions being investigated there, and future plans for improving LIGO's sensitivity. Already LIGO can detect dimensional changes smaller than the size of an atomic nucleus, and further improvements in its detection systems are being planned. A subsequent Saturday morning session is designed to acquaint non-experts with current forefront research in astronomy and astrophysics, with talks describing searches for planets outside our solar system, for sources of cosmic gamma ray bursts, and describing new studies of active galactic nuclei and cosmic rays.

Condensed matter physics - Attendees should find particularly interesting invited talk sessions on solid state nuclear magnetic resonance and on recent advances which are enabling biophysics studies on nanoscale-sized systems. These sessions are scheduled on Thursday morning and afternoon, respectively. Another talk of particular interest to this community will be a Thursday morning overview of a new class of physics and materials experiments enabled by the Jefferson Laboratory kilowatt-class high average-power, sub-picosecond free-electron laser, covering the mid-infrared spectral region.

High-energy physics – Two invited talk sessions on Thursday afternoon and Friday morning, focus respectively on physics leading up to turn-on of the Linear Hadron Collider (LHC) and on a variety of forefront topics in neutrino physics.

Nuclear physics – Our meeting this year in Williamsburg affords the opportunity to become more familiar with the research activities of the neighboring Thomas Jefferson National Accelerator Facility in Newport News, which became operational for physics measurements a decade ago. Electron beams of up to 6 GeV from this accelerator have enabled highly sensitive studies of the quark-gluon substructure of nucleons and nuclei. Two sessions of invited talks on Thursday and Friday mornings will highlight JLab research. Talks in the first session focus on how Jefferson Lab was developed by regional scientists, and on research highlights which have emerged from the nuclear physics program and from an allied beam physics and materials studies program enabled by a unique, high-powered free-electron laser. The second session focuses on plans and experimental motivation for a recently approved upgrade of the accelerator and associated experimental equipment to enable studies with beams of energy up to 12 GeV.

Physics and society - On Thursday evening, a plenary session will focus on the societal challenges which loom as growing global economies and populations face energy limits imposed by the coming era of peak oil production. The Friday evening banquet speaker will highlight efforts being spearheaded by scientists in the Southeast to utilize widening arrays of networked sensors and rapidly advancing technologies of grid computing for real-time modeling of the enormous coastal hurricanes which periodically threaten our region.

Physics workforce education – A recent National Academy report, *Rising Above The Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, suggests an urgent need to train the nation's future scientific workforce, to enable continued US economic competitiveness. In a Saturday morning session, an introduction to the topic will be provided by the Deputy Staff Director for the U.S. House of Representatives Committee on Science, who will also discuss the FY07 federal budget response to this report. Others will then address issues of best practices in educating and training physicists, how many physicists are in the academic pipeline and where they go after they graduate, and outreach programs which are trying to engage pre-college students in physics-related activities.

Information for Speakers
All meeting rooms will be equipped with LCD projectors and speakers are strongly encouraged to use electronic projection. You may use your laptop for driving the projector. However, in order to save setup time, it is strongly preferred that speakers use the conference computer for presentation. It is recommended that you bring the electronic file for your presentation either on a CD or a memory

stick. All speakers using electronic projection in contributed talk sessions should plan to arrive at the meeting room at least 20 minutes prior to the start of the session to check that the technology will work with minimum delay between speakers. Overhead projectors will also be available for those who prefer using transparencies. The meeting hotel is also equipped with wireless access to the Internet. Any laptop with wireless capability will be able to use this feature, though there may be a fee assessed for this use.

Jefferson Lab and Tour
The Department of Energy's Thomas Jefferson National Accelerator Facility was constructed between 1987 and 1994. Full-scale operation for physics experiments with its Continuous Electron Beam Accelerator Facility (CEBAF), based on superconducting radio-frequency accelerating technology, began in 1997. This is the world's most advanced electron accelerator for investigating the quark-gluon sub-structure of the atomic nucleus.

Today JLab employs over 500 staff members and serves a nuclear physics user community of over 2000 international scientists, including many faculty and students from the SESAPS region. With industry, defense and university partners, Jefferson Lab has a derivative mission as well: applied research for using its free-electron lasers based on technology the laboratory developed to conduct its nuclear physics program.

Buses will leave the Williamsburg Hospitality House beginning at 1 PM on Friday, November 10th for the 17-mile trip to Jefferson Lab. Once there, visitors will circulate among six sites, where they can see the CEBAF accelerator and its operations center, experimental halls where beams interact with targets to explore details of the sub-nuclear force, and a kilowatt-class high average-power, sub-picosecond free-electron laser, covering the mid-infrared and ultraviolet spectral region. Buses will be available to return visitors to the Williamsburg Hospitality House until 5 PM.

SPECIAL JLab TOUR NOTE:
You must be 18 years old or over to attend the tour. There will be a lot of walking. Safety requirements dictate pants and close-toed shoes with no sandals or high heels. Note that the accelerator portion of the tour is NOT handicapped accessible and you must be able to walk up and down four flights of stairs. *Important Notice for JLab visitors who were born outside the United States.* U.S. Department of Energy headquarters approval is required before any persons whose country of birth is Cuba, Iran, North Korea, Sudan or Syria can enter DOE facilities, including Jefferson Lab. Visitors from these countries may not be on site or tour Jefferson Lab without first going through this formal approval process. This process may take up to six (6) months. Please contact Linda Ware at ware@jlab.org if you have questions or need to apply to the DOE for approval to participate in the tour.

Registration
Packets for persons who pre-register before arriving will be available at the registration desk at the Williamsburg Hospitality House between 6 and 8 PM on Wednesday, Nov. 8th, and on subsequent days during the daytime meeting sessions.

The registration fees for the SESAPS06 meeting are: SESAPS and APS members, $60; non-members, $80; retired APS members, $30; graduate students, $30; undergraduates, free; banquet fee, $35. The SESAPS Program, Beams, and Slack awardees and the banquet speaker will not pay the registration or banquet fee.

Special Programs for Undergraduates
The Society of Physics Students (SPS) at the College of William & Mary is hosting a parallel meeting of Zone 6 that will include separately organized poster and contributed talk sessions on Friday morning All students who present at one of the SPS sessions are eligible for the Marsh White Award, which will be given to the best undergraduate presenter. Because of the necessity for judging, undergraduate students who present at the regular SESAPS sessions will not be eligible for this award. There will be SPS social events as well, including a student dinner on Friday evening and a talk by Patrick Troutman of the NASA Langley Research Center entitled "NASA's New National Vision for Space Exploration: Back to the Moon, then onto Mars and Beyond."

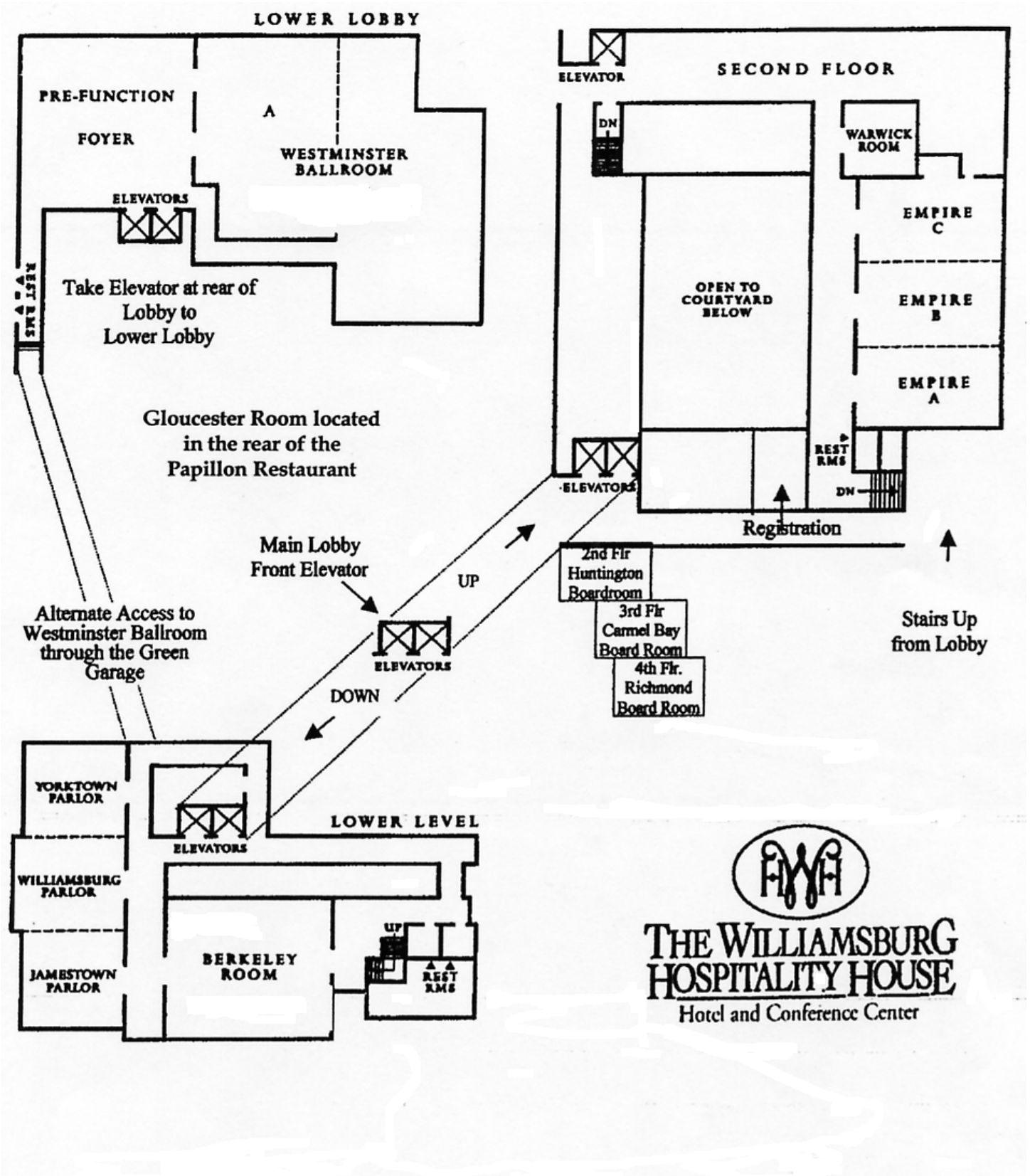
On Saturday the SESAPS and the National Society of Black Physicists (NSBP) will host a light luncheon in 215/216 Tucker Hall on the William & Mary campus during which there will be discussion of graduate school opportunities and application strategies. This will be led by Prof. Marc Sher of the William & Mary Physics Department and other regional faculty experienced in undergraduate advising and graduate recruiting. Following this, the NSBP will lead a training session for undergraduates focused on providing information and advice about how best to prepare for taking the GRE physics subject test.

Future Meetings
The next annual meeting of SESAPS will be co-hosted by Fisk and Vanderbilt Universities and will be held in Nashville, TN. Local contact persons for the meeting are Steve Morgan, smorgan@fisk.edu and David Ernst, david.j.ernst@vanderbilt.edu. The Fall 2008 SESAPS meeting will be hosted in Raleigh, NC by NC State University.

For help or further information
There are three primary SESAPS06 meeting contacts. Prof. Marc Sher, Chair of the Local Organizing Committee, can be reached at (757)-221-3538 or sher@physics.wm.edu; Prof. Thomas Clegg, Chair of the Program Committee can be reached at (919)-843-8168 or clegg@physics.unc.edu. Questions about details of the Friday afternoon, Nov. 10th tour of Jefferson Lab should be directed to Linda Ware at (757)-269-7689 or ware@jlab.org.

Meeting Site

The conference hotel is the Williamsburg Hospitality House located in downtown Williamsburg adjacent to the William and Mary campus at 415 Richmond Road, Williamsburg, VA 23185-3536; Phone: 757-229-4020; FAX: (757)-220-1560. The Wednesday evening reception, all scientific sessions, and the Friday evening banquet will take place at this hotel. Meeting participants are expected to make their own hotel arrangements.



SESSION BA SOLID STATE NMR

Invited Session

Williamsburg Hospitality House, Empire A/B — Chair: Gina Hoatson (College of William & Mary)

Thursday, November 9, 2006 8:30 AM - 10:30 AM

8:30 AM

BA.00001 - Local Structure in PMSN Across the Ferroelectric Phase Transition[1] , *ROBERT VOLD, College of William and Mary* — Local structure and ^{93}Nb ion displacement play vital roles in the ferroelectric polarization and phase transitions of solid solutions with composition (1-x)$PbMg_{1/3}Nb_{2/3}O_3$- x $PbSc_{1/2}Nb_{1/2}O_3$ (PMSN). Here, we report variable temperature, high field (17.6 Tesla) ^{93}Nb MAS and 3QMAS NMR studies of PMSN with compositions between x = 0.6 and 0 (pure PMN). In PMSN, six narrow components and one broad peak were observed. Spectral assignments agree with previous reports [D.H.Zhou, G.L.Hoatson, R.L.Vold, J. Magn. Reson. 167 (2004) 242-252 and references therein]. The broad peak is resolved only at temperatures below the dielectric susceptibility maximum (i.e., $T < T_c$). This peak represents niobium ions in configurations that contain at least one other niobium in the shell of next nearest B-site neighbors. Decreasing temperature results in broadening of all lines, most notably the distribution peak; its line width increases by nearly a factor of two between 320 and 240 K. 3QMAS spectra show that the broadening of the distribution peak is mainly due to an increase in the distribution of quadrupolar parameters, resulting from asymmetric ion displacements and bond length variations. These changes occur continuously across the broad ferroelectric relaxor phase transition, and allow conclusions to be drawn regarding the chemical composition of polar nanoclusters.

In collaboration with Gina Hoatson and Murugesan Vijayakumar, College of William & Mary.

[1]This work was supported by the Office of Naval Research, Grant N000140310661, and the National Science Foundation, Grant CHE0079136.

9:00 AM

BA.00002 - Hydrogen Adsorption in Carbon-Based Materials Studied by NMR[1], *YUE WU, University of North Carolina-Chapel Hill* — Hydrogen storage is a key component for hydrogen economy. So far, storage materials with large storage capacity and suitable adsorption energy remain elusive. The identification of future storage materials depends crucially on the understanding of adsorption mechanisms. Here we show that nuclear magnetic resonance (NMR) is a sensitive and quantitative probe for detecting adsorbed gas molecules (such as H_2, methane, and ethane) in carbon-based materials [1]. Adsorbed gas molecules can be identified through characteristic NMR signatures such as spectral lineshape and spin dynamics, which are determined by the distinct dynamic properties of the adsorbed molecules. NMR is shown to be valuable for the understanding of adsorption mechanisms. In our studies, NMR measurements were carried out in-situ under given H_2 pressure up to a pressure of over 100 atm. From such ^{1}H NMR measurement, the amount of adsorbed H_2 molecules can be determined versus pressure. This gives an alternative method for measuring the adsorption isotherms where the H_2 signature is identified based on spin properties rather than weight or volume as in gravimetric and volumetric measurements. In addition, properties of molecular dynamics can be obtained at the same time providing information on the adsorption mechanisms.

[1] A. Kleinhammes, S.-H. Mao, X.-J. Yang, X.-P. Tang, H. Shimoda, J. P. Lu, O. Zhou, and Y. Wu, *Phys. Rev. B.* **68**, 075418 (2003).

[1]This work is supported by DOE.

9:30 AM

BA.00003 - Advances to Enable ^{69,71}Ga Nuclear Magnetic Resonance of Thin GaN Films, *JAMES YESINOWSKI, Naval Research Laboratory* — High-field ^{69,71}Ga Nuclear Magnetic Resonance (NMR) spectroscopy of GaN has recently been shown to be a valuable quantitative characterization technique sensitive to the presence of dopants and defects, polytypes, and distributions of carrier concentrations [1-3]. We report several new approaches that greatly improve the ^{69,71}Ga detection sensitivity and have enabled study of single 3μm thin films of GaN. NMR investigation of submicron films should now be feasible.

References

[1] J.P. Yesinowski and A.P. Purdy, J. Amer. Chem. Soc., 126, 9166 (2004).

[2] J.P. Yesinowski: phys. status sol. (c), 2, 2399 (2005).

[3] J.P. Yesinowski, A.P. Purdy, H. Wu, M.G. Spencer, J. Hunting, F.J. DiSalvo: J. Amer. Chem. Soc., 128, 4952 (2006).

10:00 AM

BA.00004 - Condensed Matter NMR under Extreme Conditions: Challenges and Opportunities, *ARNEIL REYES, National High Magnetic Field Laboratory* — Advances in resistive magnet and power supply technology have made available extremely high magnetic fields suitable for condensed matter broadline NMR experiments. This capability expands the available phase space for investigating a wide variety of materials using magnetic resonance; utilizing the strength of the field to expose or induce new physical phenomena resulting in better understanding of the physics. Continuous fields up to 45T in NHMFL Hybrid magnet have brought new challenges in designing NMR instrumentation. Field strengths and sample space limitations put constraints on RF pulse power, tuning range, bandwidth, and temperature control. The inclusion of other capabilities, including high pressure, optics, and sample rotation requires intricate probe design and construction, while extremely low milliKelvin temperatures are desired in order to explore energy scales where thermal fluctuations are suppressed. Optimization of these devices has been of paramount consideration in NHMFL Condensed Matter NMR user program. Science achieved at high fields, the new initiatives to develop resistively-detected NMR in 2D electron gas and similar systems, and the current new generation Series-Connected Hybrid magnets for NMR work will be discussed. The NHMFL is supported by the National Science Foundation and the State of Florida.

SESSION BB NUCLEAR PHYSICS I

Williamsburg Hospitality House, Jamestown
Chair: Gerald Feldman (George Washington University)
Thursday, November 9, 2006 8:30 AM - 10:30 AM

8:30 AM

BB.00001 - The NPDGamma Experiment: Hadronic Parity Violation in the Radiative Capture of Polarized Cold Neutrons on Protons[1] , *MICHAEL GERICKE, TJNAF/ U. of Manitoba, NPDGAMMA COLLABORATION* — The NPDGamma experiment is currently taking data to measure the parity-violating correlation A_γ between the neutron spin and photon direction in the capture of polarized cold neutrons on hydrogen, to a precision 5×10^{-9}, 10% of the expected value. This asymmetry measures the neutral weak hadronic coupling without the complicating effects of nuclear structure. The first phase of the experiment, at Los Alamos National Laboratory, will provide an upper limit at the 10^{-7} accuracy and phase two is proposed to run as the first experiment on the new fundamental neutron physics beam line at the Spallation Neutron Source at Oak Ridge National Laboratory. An overview of the experiment and related physics will be provided, together with a preliminary analysis of the phase 1 data.

[1]DOE, NSF, NSERC.

8:42 AM

BB.00002 - Measurements of the $^1S_0$ Scattering Lengths in Neutron-Deuteron Breakup at 19 MeV in a Coincidence Geometry[1] , *A.S. CROWELL, J. DENG, J.H. ESTERLINE, C.R. HOWELL, M.R. KISER, R.A. MACRI, S. TAJIMA, W. TORNOW, Duke University and TUNL, B.J. CROWE III, North Carolina Central University, R.S. PEDRONI, North Carolina A&T State University, W. VON WITSCH, University of Bonn, H. WITAŁA, Jagellonian University* — Measurements of the $^1S_0$ neutron-neutron (nn) and neutron-proton (np) scattering lengths, a_{nn} and a_{np} respectively, using neutron-induced deuteron breakup were made at Triangle Universities Nuclear Laboratory (TUNL) at an incident neutron energy of 19.0 MeV. Six liquid scintillator detectors were configured in a coincidence geometry to measure the momenta of the two neutrons in two nn and np final-state-interaction (FSI) pairs while the energy of the proton was determined using a C_6D_{12} active target. The scattering lengths were extracted from the experimental cross sections by comparison to rigorous three-nucleon calculations using the CD Bonn nucleon-nucleon potential for various values of a_{nn} and a_{np}. In this talk results from the two nn and np FSI measurements and the analysis to obtain a_{nn} will be presented.

[1]This work was supported in part by USDOE Grant No. DE-FG02-97-ER41033

8:54 AM

BB.00003 - Identification of levels in ^{144}Cs , *E.F. JONES, P.M. GORE, Y.X. LUO, J.H. HAMILTON, A.V. RAMAYYA, J.K. HWANG, H.L. CROWELL, K. LI, C.T. GOODIN, Dept. of Physics, Vanderbilt Univ., Nashville, Tennessee 37235, U.S.A., J.O. RASMUSSEN, Lawrence Berkeley National Laboratory, Berkeley, California 94720, U.S.A., S.J. ZHU, Dept. of Physics, Tsinghua Univ., Beijing, P. R. China* — From the analysis of γ-γ-γ coincidence data taken with Gammasphere of the prompt γ rays in the spontaneous fission of ^{252}Cf, a cascade of six transitions, at 108.0, 115.1, 263.8, 404.8, 535.2, and tentatively 679.5 keV, was identified in ^{144}Cs for the first time. The transitions were assigned to a cascade with these energies in ^{144}Cs from their relative intensities and by identifying their coincidences with the known transitions in ^{105}Tc and ^{106}Tc, the 3n and 2n fission partners of ^{144}Cs, and comparing the Tc intensities to the respective Tc yield tables. The energy levels in ^{138,140,142}Cs with N = 83, 85, and 87, respectively, just above the spherical closed shell at N = 82, each have first excited states around 10 keV and second excited states between 16 and 65 keV, and no rotational type bands. These states are associated with single particle states in the spherical region. With N = 89 in ^{144}Cs, one has crossed the region between N = 88 and 90 where there is a rather sudden change from spherical nuclei with $N \leq 88$ to significant deformation in $N \geq 90$ nuclei. The levels in ^{144}Cs look like a rotational band in a more well-deformed nucleus.

9:06 AM

BB.00004 - New Results for the Intensity of Bimodal Fission in Ba Channels of the SF of ^{252}Cf , *C.T. GOODIN, D. FONG, J.K. HWANG, A.V. RAMAYYA, J.H. HAMILTON, K. LI, Vanderbilt Univ., Y.X. LUO, Vanderbilt Univ./LBNL/ JIHIR(ORNL), J.O. RASMUSSEN, S.C. WU, LBNL,*

M.A. STOYER, LLNL, T.N. GINTER, NSCL(MSU), S.J. ZHU, Vanderbilt Univ./JIHIR(ORNL)/Tsinghua Univ., R. DONANGELO, Univ. Fed. do Rio de Janeiro, G.M. TER-AKOPIAN, A.V. DANIEL, G.S. POPEKO, A.M. RODIN, A.S. FOMICHEV — Triple coincidence data from the fission of ^{252}Cf were used to deduce the intensity of the proposed "hot" mode in Barium channels. $\gamma - \gamma - \gamma$ and $\alpha - \gamma - \gamma$ fission data were analyzed to find the neutron multiplicity distribution for several binary and ternary charge splits. The binary channels Xe-Ru and Ba-Mo were analyzed, as well as the Ba-α-Zr, Mo-α-Xe, and Te-α-Ru ternary channels. An improved method of analysis was used in order to avoid many of the complexities associated with fission spectra. With this method, we were unable to confirm the second mode in either the Ba-Mo or Ba-α-Zr splits.

9:18 AM

BB.00005 - RHIC and Non-Equilibrium Signals of the Deconfining Phase Transition, *ALEXEI BAZAVOV, BERND BERG, Florida State University* — The Relativistic Heavy Ion Collsion (RHIC) experiments carried out at Brookhaven National Laboratory (BNL) provide important information about the formation and dynamical properties of Quark-Gluon Plasma (QGP). Collision of two heavy (about 200 nucleions) nuclei at the center-of-mass energy 200 GeV heats up a spatial volume of 10^3 fm^3 to temperatures at which matter undergoes a phase transition from the hadronic (confined) phase into the plasma (deconfined) phase. At these energies QCD exhibits non-perturbative regime therefore other means than perturbation theory are necessary to study the phenomena. We study the dynamics of the deconfining phase transition by performing Monte Carlo simulations in the Lattice Gauge Theory formalism. We study the response of the system to a rapid temperature quench that mimics initial heating at RHIC. We find that the deconfining phase transition proceeds through the spinodal decomposition scenario. The mechanism slowing down the equilibration of the system is a competition of domains of distinct triality (having different values of the Polyakov loop, an order parameter for pure gauge theory). We measure the structure factors and the gluonic energy and pressure densities and also relate the dynamical growth rates to the Debye screening mass. Strong correlations are found when the system is out of equilibrium but not in the final equilibrium state.

9:30 AM

BB.00006 - Monte Carlo Simulation of a Large NaI Detector Using GEANT4, *DANIEL MITTELBERGER, GERALD FELDMAN, Department of Physics, The George Washington University* — A Monte Carlo simulation of a high-resolution large-volume NaI detector has been created for the analysis of Compton scattering experiments. This simulation (based on GEANT4) models the components of the detector (a single cylindrical core and four annular quadrants) and its response to a tagged photon beam of variable energy (60-90 MeV), for both in-beam and scattering configurations. The simulation outputs the energy deposited in each component of the NaI to a file for further analysis using the ROOT data analysis package. To more accurately represent the detector lineshape, the output from the simulated in-beam geometry is fitted to experimental in-beam data using a Gaussian smearing function which helps characterize the intrinsic response function of the detector. Once this response function has been determined, the simulation can then be used to model the lineshape for a scattering run from Compton scattering on carbon. With the appropriate lineshape for the scattering geometry and with an analysis of the experimental yields, the differential cross sections for Compton scattering can be extracted from the carbon data taken at MAX-Lab in Lund, Sweden.

9:42 AM

BB.00007 - Studying neutron stars at Jefferson Lab: the PRex experiment, *DAVID S. ARMSTRONG, College of William & Mary, HAPPEX COLLABORATION* — One particularly elusive goal of nuclear structure measurements has been the determination of the radius of the neutron distribution in heavy nuclei. This basic property has yet to be cleanly measured, and a precise determination would have important implications for understanding neutron stars, testing nuclear models, heavy-ion collisions and standard model tests from atomic parity violation. An experiment will take place at Jefferson Lab, which will exploit the fact that the Z^0 boson couples primarily to neutrons in order to make a theoretically clean measurement of the neutron radius in ^{208}Pb via parity-violating elastic electron scattering. The anticipated precision on the neutron radius is 1%. The motivation, experimental technique and status of this challenging measurement will be reviewed.

9:54 AM

BB.00008 - Equation of State for low density nuclear matter, *JUTRI TARUNA, JORGE PIEKAREWICZ, Florida State University* — Neutron-rich matter at subnuclear densities–present in core-collapse supernovae and the crust of neutron stars–displays fascinating complex structures such as spherical, slablike, and rodlike shapes. The equation of state and the two-body correlation function (both spin dependent and spin independent) are computed via semi-classical Monte-Carlo simulations that incorporate a momentum-dependent two-body potential to simulate Pauli correlations.

10:06 AM

BB.00009 - Accelerate the transition of radioisotopes and unwanted weapons-grade ^{239}Pu into stable nuclei with a system of high frequency modulation for a net energy gain, *EUGENE PAMFILOFF, Dept. of Physics, Univ. of Georgia, UGA, - Optigon R and D, Vivitar, VPDM, CA, retired* — A process of high frequency stimulation of nucleons can be utilized for the accelerated fission, decay or controlled transition of unstable isotopes. ^{238}U could be persuaded to transition promptly into the stable ^{206}Pb isotope, where a portion of the total mass difference of 29873.802 MeV per nucleus becomes available energy. The proposals of this paper describe an effective system for nuclei stimulation configured to accelerate such a

series of 14 transitions over several milliseconds, instead of 4.47 x 10^9 years. Positive ions or ionized capsules of fuel suspended by magnetic fields and subjected to the system of correlated frequency modulation of multiple beam lines, tailored to the specific target, will emit sufficient energy to stimulate subsequent targets. The system can be applied to all radioisotopes, nuclear waste product isotopes such as ^{239}Pu, and a variety of other suitable unstable or stable nuclei. Through the proposed confinement system and application of high frequency stimulation in the 10^{22} to 10^{24} Hz regime, the change in mass can be applied to both the fragmentation of subsequent, periodically injected targets, and the production of heat, making a continuous supply of energy possible. The system allows the particle fragmentation process to be brought into the lab and provides potential solutions to the safe disposal of fissile material.

10:18 AM

BB.00010 - Proton configuration and mass variations are observed in each of the 3036 isotopes studied, *EUGENE PAMFILOFF, Dept. of Physics, Univ. of Georgia, UGA, - Optigon R and D, Vivitar, VPDM, retired* — The fission and decay transitions of unstable isotopes are studied with particular detailed analysis of nuclei masses, proton - neutron substructure, and the change in mass experienced by individual nucleons of parent, daughter and product isotopes. The data shows the 3036 isotopes studied contain nucleons of a mass unique to each isotope, and further, indicating 3036 proton variations, each differentiated by a distinct mass. Of these, 283 proton variations are further distinguished by belonging to stable benchmark isotopes. The same variations were found with bound neutrons. A direct correlation is observed between the nearest stable benchmark mass and the mass of the nucleon returning to ground state during the transition, indicating a mass dependence to nuclear stability. These findings indicate that a nucleus in an excited state cannot stabilize or return to the ground state until it adjusts mass to match the nearest $Z - N$ and mass per nucleon benchmark. These conclusions were further tested with the analysis of nucleon mass adjustments occurring within the natural and artificial alpha emitter nuclei. The developed system of analysis provided good results when tested against the incident and product particles of high and low energy interactions and events of nuclear transmutation. Every transition to a stable product demonstrates a strong correlation with a specific mass per nucleon benchmark as a third condition of nuclear stability.

SESSION BC ATOMIC, MOLECULAR, OPTICAL

Williamsburg Hospitality House, Yorktown
Chair: Gerald Feldman (George Washington University)
Thursday, November 9, 2006 8:30 AM - 10:30 AM

8:30 AM

BC.00001 - Time variation of the fine structure constant α from realistic models of Oklo reactors[1] , *C.R. GOULD, NC State U and TUNL, E.I. SHARAPOV, JINR, Dubna, S.K. LAMOREAUX, Yale U* — The topic of whether the fundamental constants of nature vary with time has been a subject of great interest since Dirac originally proposed the possibility that $GN \sim 1/t_{universe}$. Recent observations of absorption spectra lines from distant quasars appeared to indicate a possible increase in the fine structure constant α over ten billion years. Contrarily, analyses of the time evolution of α from Oklo natural nuclear reactor data have yielded inconsistent results, some indicating a decrease over two billion years while others indicated no change. We have used known Oklo reactor epithermal spectral indices as criteria for selecting realistic reactor models. Reactors RZ2 and RZ10 were modeled with MCNP and the resulting neutron spectra were used to calculate the change in the ^{149}Sm capture cross section as a function of a possible shift in the energy of the 97.3-meV resonance. Our study resolves the contradictory situation with previous Oklo α-results. Our suggested 2-sigma bound on a possible time variation of α over two billion years is stringent: $-0.11 \leq \frac{\Delta\alpha}{\alpha} \leq 0.24$, in units of 10^{-7}, but model dependent in that it assumes only α has varied over time.

[1]Work support in part by Office of Nuclear Physics, US DOE

8:54 AM

BC.00002 - The Quantum, Semiclassical & Classical Monodromy of Hydrogenic Atomic States in Perpendicular and Near Perpendicular External Electric and Magnetic Fields, *CHRIS SCHLEIF, JOHN DELOS, William & Mary* — We construct a classical integrable approximation for Hydrogen in perpendicular and nearly perpendicular external electric and magnetic fields and show that for a certain range of field strength ratios and angles, classical action variables can only be consistently defined locally on connected integrable regions of phase space. This effect, called classical Monodromy, is a result of the global organizational structure of the invariant manifolds in the phase space of this approximate system. EBKM quantization of classical actions is then used to construct a lattice of semiclassical eigenstates. For n manifolds containing a sufficient number of eigenstates, the semiclassical spectrum contains a lattice defect whenever the underlying classical system has classical Monodromy. Finally we use standard quantum perturbation theory to produce a quantum spectrum for Hydrogenic states in external fields. We find that for system parameters where the classical Monodromy is present, a lattice defect appears in the spectrum of quantum eigenstates. We find that our classical system accurately predicts all features of

this Quantum Monodromy including excellent agreement between the classical bifurcation of a doubly pinched torus into 2 singly pinched tori, and a Quantum bifurcation of the lattice defect from a single [1 2 ; 0 1] defect into two distinctive [1 1 ; 0 1] defects.

9:06 AM

BC.00003 - Longitudinal Stern-Gerlach, *DOUGLAS HIGINBOTHAM, Jefferson Lab* — In 1922 Otto Stern and Walther Gerlach split a beam of silver atoms using a transverse gradient field. This experiment, which lead to the understanding that electrons have intrinsic spin, oddly enough does not work for free electrons due to the interplay between the Lorentz force and Heisenberg uncertainly principle. Recent calculations, Phys. Rev. Lett. 79 (1997) 4517 and Phys. Rev. Lett. 86 (2001) 4508, have shown that a dismissed idea of L. Brillouin from 1928 to use a longitudinal gradient field to minimize the effect of the Lorentz force may in fact be possible. The history of the Stern-Gerlach device will be presented along with the revived ideas for separating a beam of free electrons into its two spin states.

9:18 AM

BC.00004 - Using Time of Flight Mass Spectrometry to Determine Temperature[1], *JAMES GLEESON, JAMES COWART, ANTHONY CALAMAI, ADRIAN DAW, Appalachian State University* — In support of measurements of rate coeffcients and other atomic and molecular parameters for astronomy and astrophysics, we are developing a method of obtaining and analyzing time of flight spectra (TOFS). This is analogous to obtaining temperatures from profiles of optical emission lines. Using a cylindrical RF ion trap, ion clouds were generated by bombarding H_2 and N_2 gas at nano-torr pressures with electrons having roughly 100 eV of kinetic energy. The ion clouds were ejected from the trap by applying voltage pulses to the trap end caps, and detected using an electron multiplier. The voltage, rise time, and RF phase of the ejection pulse were varied to obtain either the best charge-to-mass resolution or to obtain the best information on the energy distribution of stored ions. The TOFS produced under these conditions were modeled and simulated using Sim-Ion 7.0 ion optics software. The experiment and simulation data are compared and information pertaining to the kinetic energies of the ions in the generated ion cloud is presented.

[1]This work is supported in part by NSF grant AST-04-06706 and Research Corporation grant CC6409 to ASU.

9:30 AM

BC.00005 - Effects of ion trap electrode geometry on ion storage and extraction[1], *JAMES COWART, JAMES GLEESON, ANTHONY CALAMAI, ADRIAN DAW, Appalachian State University Department of Physics and Astronomy* — The ion trap laboratory at Appalachian State University is measuring rate coeffcients and other fundamental atomic and molecular parameters for astronomy and astrophysics. To obtain more detailed information on the energy distribution of ions stored in an RF ion trap, a detailed model of the trap has been constructed using IDL and Simion 7.0. Effects of details of the trap electrode geometry on ion storage and the process for ion extraction and detection are presented.

[1]This work is supported in part by NSF grant AST-04-06706 and Research Corporation grant CC6409 to ASU

9:42 AM

BC.00006 - Photodetachment spectroscopy near the lowest threshold of the S^- ion[1] , *JOHN N. YUKICH, JAMES E. WELLS, Davidson College* — Numerous experiments have investigated photodetachment spectroscopy in a magnetic field at the $^2P_{3/2} \rightarrow {}^3P_2$ threshold, also known as the *electron affinity* for S^-. In this work we have investigated detachment at the $^2P_{1/2} \rightarrow {}^3P_2$ threshold, which is the lowest-lying threshold for the S^- ion. Our experimental apparatus includes a Penning ion trap in which the ions are created, trapped and stored. Our observations yield a quantitative measurement for the threshold energy and an indirect measurement for the spin-orbit splitting of the ion.

[1]Support from the Petroleum Research Fund and Davidson College

9:54 AM

BC.00007 - Rotational Spectroscopy of the Excited States of Nitric Acid[1] , *PAUL HELMINGER, University of South Alabama, DOUGLAS T. PETKIE, Wright State University, IVAN MEDVEDEV, ATSUKO MAEDA, FRANK C. DE LUCIA, Ohio State University* — Because it is an important molecular species in the ozone cycle in the upper atmosphere, nitric acid (HNO_3) has been the subject of many studies in both the infrared and in the microwave region of the spectrum. Our microwave studies of the rotational spectrum of nitric acid now include work on all of the excited states below 1200 cm^{-1} in energy as well a few states at higher energy, such as the v2 state at 1700 cm^{-1}. Microwave studies of the rotational spectrum of HNO_3 in excited vibration states contribute both to a better understanding of this fundamental molecule and to the construction of accurate spectral maps for infrared remote sensing. An overview of our studies of the rotational spectroscopy of the excited states will be presented, including our observation of torsion splitting in a number of states. Our recent progress on the assignment and analysis of transitions other states will also be presented.

[1]This work is supported by NASA

10:06 AM

BC.00008 - Resonantly Enhanced Multiphoton Ionization Circular Dichroism (REMPICD), *WATHEQ AL-BASHEER, RUNHUA LI, RODNEY SULLIVAN, RICHARD PAGNI, ROBERT COMPTON, The University of Tennessee Knoxville* — Linear and non-linear circular dichroism of *R*-(+)-3-methylcyclopentanone is reported in the gas and liquid phase. Measurements of (2+1) resonance-enhanced multiphoton ionization circular dichroism (REMPICD) for nozzle-jet expanded molecular beams of the equatorial conformer of *R*-3MCP are presented. Monitoring either

mass-selected cations or photo-electrons produced via (2+1) REMPI through the $n \rightarrow 3s$ Rydberg transition yielded a REM-PICD of +1.5± 0.5% [REMPICD $\equiv 2(I_L - I_R)/(I_L + I_R)$, where $I_{L/R}$ refers to the ion/electron signal for left-/right-circularly polarized light]. A racemic mixture of 3-methylcyclopentanone showed no significant CD. The REMPICD is larger and of opposite sign than the 1-photon CD at the $n \rightarrow 3s$ transition. It appears that the REMPICD is dominated by the continuum transition. Measurements of 1-photon CD as a function of temperature provides information on the enthalpy difference between the equatorial and axial conformers of 3MCP. Density Function Theory calculations also support these measurements.

10:18 AM

BC.00009 - Negative Power Subflows in High Contrast Step-Index Cylindrical Fibers, *SERGIY MOKHOV, CREOL, UCF, Orlando, FL* — Single-mode waveguides with high contrast between guiding and cladding refractive indices become experimentally available. Strong modal dispersion of them significantly changes properties of propagation of pulses. The hybrid-mode analysis of step-index cylindrical fiber expresses basic dispersion properties of fibers with high contrast. In this case analytical dispersion relation depends on dimensionless contrast and normalized frequency. It's interesting that the fundamental mode HE_{11} in fiber with contrast more than 2.7 can have the distribution of powerflow with regions of negative values. This slightly investigated effect can have some nano-technological applications. The analytic form of dispersion equations for fibers with simple profiles are useful because propagation constants and their derivatives can be calculated with high accuracy. The problem of the coaxial step-index fiber is considered in detail. Distortions of transversal electromagnetic fields are stronger due to the presence of the low index inner cylinder so the occurrence of negative power subflows is possible at smaller contrast in comparison with the simple step-index fiber.

SESSION CA JEFFERSON LAB: THE FIRST TEN YEARS

Invited Session

Williamsburg Hospitality House, Empire A/B — Chair: Marc Sher (College of William & Mary)

Thursday, November 9, 2006 10:45 AM - 12:33 PM

10:45 AM

CA.00001 - Early History of Jefferson Laboratory[1], *FRANZ GROSS, Jefferson Laboratory and the College of William and Mary* — This talk will focus on the history of Jefferson Laboratory from its inception as the NEAL proposal by the Southeastern Universities Research Association (SURA) in 1980, to about 1986 – two years after the arrival of Hermann Grunder and his Berkeley team. Major themes are (i) a national decision to build a high energy, high duty factor electron accelerator for basic nuclear physics research, (ii) open competition established by the DOE, (iii) formation of SURA, and (iv) interest of SURA physicists (particularly at UVA and W&M) in this research. I will discuss the scientific, technical, and political issues that eventually lead to the choice of Newport News as the site and the choice of a recirculating superconducting ring as the final design.

[1]Supported by Jefferson Science Associates, LLC under U.S. DOE Contract No. DE-AC05-06OR23177. The U.S. Government retains a non-exclusive, paid-up, irrevocable, world-wide license to reproduce this manuscript for U.S. Government purposes.

11:21 AM

CA.00002 - Highlights from the first 10 years of Physics Experiments at JLab, *ROLF ENT, Jefferson Lab* — The first Nuclear Physics experiments using the CEBAF accelerator at Jefferson Lab started in 1995. In this presentation, an overview will be given of the science highlights of Jefferson Lab experiments. It will be shown that the past 10 years have produced a rich array of science results, that have drastically changed our view of the role of quarks in protons and in atomic nuclei.

11:57 AM

CA.00003 - Addressing Physics Grand Challenges Using the Jefferson Lab FEL[1], *GWYN P. WILLIAMS[2], Jefferson Lab* — The Jefferson Lab Free Electron Laser[1] is the first of the so-called 4th generation light sources to go operational. Capable of delivering extraordinarily bright, tunable light in ultrafast pulses from THz[2] through infrared to UV, the facility extends the experimental reach of accelerator-based light-sources by many orders of magnitude. This allows new opportunities to study many of the “Grand Challenges” recently defined by the Office of Science, Basic Energy Sciences Division, most of which are concerned with understandings of equilibrium and non-equilibrium behavior of materials in physics, chemistry and biology using precise pump and probe techniques. Specifically, in condensed matter physics, the JLab FEL permits new studies which go beyond earlier studies of reductionist behavior to those which examine emergent behavior. Thus, the understanding of high Tc superconductivity, colossal magneto-resistance, and observations of the breakdown of the Born-Oppenheimer approximation, are examples of collective behavior which is now treated theoretically via the concept of quasiparticles. In this presentation we will describe the dual pathways of light source development and physics challenges, and then show how they are combined in experiments that allow new insights to be developed to understand material function. We will illustrate this with details of the evolution of accelerator-based light sources, and with examples of work performed to date.

References:

[1] Neil et al. Phys. Rev.Letts **84**, 662 (2000).

[2] Carr, Martin, McKinney, Neil, Jordan & Williams, Nature **420**, 153 (2002).

[1]This work supported by the Office of Naval Research, the Joint Technology Office, the Commonwealth of Virginia, the Army Night Vision Laboratory, the Air Force Research Laboratory, and by DOE Contract DE-AC05-84ER40150.

[2]and the FEL Team

SESSION CB MATERIALS I

Williamsburg Hospitality House, Jamestown
Chair: Mary Ellen Zvanut (University of Alabama at Birmingham)
Thursday, November 9, 2006 10:45 AM - 12:33 PM

10:45 AM
CB.00001 - Neutron diffraction study of water intercalation in superconducting sodium cobaltate, *CINZIA METALLO, University of Tennessee, TAKESHI EGAMI, University of Tennessee/ORNL, THOMAS PROFFEN, LANL, DAVID MANDRUS, BRIAN SALES, ORNL* — Neutron powder diffraction has been used to investigate the role of heavy water in deuterated sodium cobaltate $Na_{0.35}CoO_2 1.4D_2O$. In spite of the fact that superconductivity appears exclusively when water is intercalated in the (non superconducting) Na-deficient Na $_x CoO_2$, a clear understanding of the role of water has not been achieved. Neutron diffraction data at two different temperatures (T=15K, 100K) were analyzed using the Pair Density Function (PDF) technique, which gives information about local ordering in real space. The measured and calculated PDFs of $Na_{0.7}CoO_2$, $Na_{0.35}CoO_2 1.4D_2O$ and D_2O were compared. At both temperatures the D-D distance and the D-O-D angle in $Na_{0.35}CoO_2 1.4D_2O$ are significantly different from those of ordinary water. Two wide coexisting distributions of possible D-O-D bond angles are observed. We speculate that the altered geometry of the intercalated water molecules is due to a modification of the dynamics of the hydrogen bond. The possible implications are discussed in terms of electron conduction and superconductivity.

10:57 AM
CB.00002 - EXAFS investigation of the amorphous $Ge_2Sb_2Te_5$ optical memory material, *JOSEPH WASHINGTON, DAVID BAKER, GERALD LUCOVSKY, MICHAEL PAESLER, North Carolina State University, CRAIG TAYLOR, Colorado School of Mines* — Studies of amorphous (a-) semiconductors have been driven by technological advances as well as fundamental theories. Observation of electrical switching, for example, fueled early interest in a-chalcogenides. More recently a-chalcogenide switching has been applied successfully to programmable memory devices, as well as DVD technology where the quest for the discovery of better-suited materials continues. Thus, switching grants researchers today with an active arena of technological as well as fundamental study. Bond constraint theory and rigidity theory provide a powerful framework for understanding the structure and properties of a materials. Application of these theories to switching in a-chalcogenides, combined with Extended X-ray Absorption Fine Structure (EXAFS) spectroscopy yields the most detailed model to date of the a-$Ge_2Sb_2Te_5$ system.

11:09 AM
CB.00003 - First Principles Study of FCC-HCP Interface Dynamics Under Uniaxial Tension, *SUNGHO KIM, SEONG-GON KIM, MARK F. HORSTEMEYER, Mississippi State University* — We studied the dynamics of FCC-HCP interface of Ni crystal at various tension using first-principles density functional theory(DFT) calculations. Both FCC and HCP structures are closed-packed and different stacking orders. We found that FCC-HCP interfaces can have two different stacking orders. We found that the interface can advance by alternating between two stacking orders under uniaxial tension. Intermediate phases and energy bariers for grain growth of two different phases will be presented.

11:21 AM
CB.00004 - A First-principles Study of GaSb(001) Surface Reconstruction, *SEONG-GON KIM, JEFFERY HOUZE, SUNGHO KIM, Mississippi State University, STEVEN C. ERWIN, Naval Research Laboratory* — We use total-energy and electronic structure calculations based on density functional theory to study the structure of GaSb(001) growth surfaces. We consider different reconstruction models proposed in the literature on the basis of experimental observations under typical GaSb growth conditions and present the T = 0 surface stability diagram. We found that all ($n \times 5$)-like reconstructions proposed in various literature have too high surface formation energies to adequately model the structures observed experimentally under typical Sb-rich growth conditions. We found several new reconstruction models for GaSb(001) surface with correct symmetries that have lower surface formation energies than existing models and produce correct STM images.

11:33 AM
CB.00005 - Optical Excitation Study of Defects in Strontium Titanate Substrates, *SHEHNAZ JEDDY, M.E. ZVANUT, University of Alabama at Birmingham, 35294, USA* — $BiFeO_3$ thin films on $SrTiO_3$ (STO) substrates exhibit great potential for novel applications. Understanding substrate structure is critical in designing and controlling ferroelectric and magnetoresistive responses of the thin films. Hence, defect levels in STO are being studied using 9.4 GHz electron paramagnetic resonance (EPR) at room temperature before and during optical excitation using a 500 W Hg arc lamp. Initial EPR of STO reveal three defects: Cr^{3+}, cubic Fe^{3+} and axial Fe^{3+}. Photo induced EPR intensity as a function of the photon energy is measured to determine defect levels and charge transfer effects with respect to the band gap. Preliminary investigation in the energy range 0.51eV to 5.06 eV reveal varying responses of defect centers. Data show Cr^{3+} is unaffected up to 1.3 eV, increasing by a factor of 2 with a peak at 2.0 eV. Both cubic and axial Fe^{3+} show no response with our present system. The changes seen in Cr^{3+} may be due to Cr^{3+} being converted to Cr^{2+} or Cr^{4+}. Further optical study using time dependant photo EPR will be done to enable deeper understanding of defect levels.

11:45 AM

CB.00006 - Effects of heat treatments on defects in strontium titanate substrates for magnetoelectric multiferroics[1], *BRIAN LASSITER, University of Idaho, MARY ELLEN ZVANUT, University of Alabama, Birmingham* — $SrTiO_3$ (STO) shows potential as a substrate for deposition of thin film multiferroic devices; however, there is little research on the effects of heat treatments under ambient conditions and temperature ranges where deposition typically occurs. To this effect, defects in STO are analyzed using electron paramagnetic resonance (EPR) at room temperature after anneals in the temperature range 200-500º C in argon, oxygen, and vacuum. These conditions are similar to those used in the deposition of bismuth ferrite (BFO), which are thought to have enhanced ferroelectric properties. Three different defects, common in bulk STO, are observed in the as-received substrates: Fe^{+3}, Cr^{+3}, and a proposed $Fe^{+3}V_O$ complex. The data trends show Cr^{3+} decreasing during oxygen anneals, Fe^{3+} remaining negligibly affected for most cases, and Cr^{3+} and $Fe^{+3}V_O$ increasing between 2 to 5 times during vacuum anneals. The increase in $Fe^{3+}V_O$ supports the conclusion that there is considerable in-diffusion of oxygen occurring during the vacuum anneals, but higher temperature may be required to replace the oxygen
and fill the vacancy.

[1]This work is supported by Dr. Collin Wood, ONR, and The NSF - Research Experience for Undergraduates (REU) site award to the University of Alabama at Birmingham under Grant No. DMR-0243640

11:57 AM

CB.00007 - Mid-infrared spectroscopy of Praseodymium doped Ternary Lead Halides, *PETER AMEDZAKE, EI BROWN, UWE HOMMERICH, MORONKEJI BANDELE, Hampton University, SUDHIR TRIVEDI, Brimrose Corporation of America, JOHN ZAVADA, US Army Research Office* — Solid-state lasers operating in the mid-infrared (MIR) wavelength (3-5μm) region are important for applications such as remote sensing of biochemical agents and military countermeasures. Solid-state laser hosts based on oxide and fluoride crystals are limited by non-radiative decay through multi-phonon relaxation. Ternary lead halides have recently become of interest as new hosts for mid-infrared gain media because of their low maximum phonon energies ranging from 140 to 205 cm^{-1}. The low-phonon energies allow for efficient rare earth emission at mid-infrared wavelengths. In this paper we report on the optical properties of several Pr^{3+} doped ternary lead halides including KPb_2Cl_5, $RbPb_2Cl_5$,KPb_2Br_5, and $RbPb_2Br_5$. The crystals were grown using a self-seeded Brigdman technique. Broad MIR emission spectra centered on ~ 4.6 μm with a band width of ~ 0.9 μm were observed upon optical excitation at 1.907 μm. Room temperature lifetimes varied between 1.5 ms and 5.0 ms depending on the host composition. More details of MIR emission properties and energy level assignments will be presented at the conference.

12:09 PM

CB.00008 - Modeling defect level occupation for recombination statistics[1], *ADAM TOPAZ, TIM GFROERER, Davidson College, MARK WANLASS, NREL* — Measurements of luminescence intensity as a function of temperature and laser illumination can provide considerable insight into the energy level distribution and recombination statistics of a semiconductor. Since the radiative recombination rate is proportional to the product of carrier densities in the valence and conduction bands, measurements of radiative efficiency vs. photoexcitation reveal how non-radiative, defect-related recombination mechanisms vary with band occupation. In this context, recent experimental results for a high-quality GaAs/GaInP double heterostructure contain two informative features. First, the radiative efficiency increases with temperature, indicating that shallow nonradiative recombination centers are being thermally depleted. Second, the defect-related recombination rate increases unusually slowly against the band carrier density product. Using a sophisticated model for non-equilibrium band and defect level occupation, we show that this latter result requires an asymmetric distribution of defect levels within the gap. Trap filling produces a rapid increase in that carriers band occupation, while the density of carriers in the band responsible for defect-related recombination remains nearly constant, such that the product increases without augmenting the recombination rate appreciably.

[1]Supported by the Amer. Chem. Soc. - Petroleum Research Fund

12:21 PM

CB.00009 - High Resolution Acoustoelastic Measurements of Materials[1], *MARK MCKENNA, SAMUEL GUY, JOSEPH HEYMAN, Luna Innovations Incorporated* — As materials become more complex, there is an increasing need for high resolution measurements to characterize strength and damage in the materials. Typically, the criterion for rejecting a part is based on the detection of a flaw of a specific size in a critical location. Interestingly, if a low stress field exists at the flaw site, the flaw may not grow over time. Similarly, in a part that shows no unacceptable indications, a high stress state may cause the flaw to quickly grow through the part leading to failure. In other cases, a controlled amount of stress (in a specific direction or type) is purposely added to the material to prevent flaw growth. Inspection time intervals are based knowing and controlling the stress environment to predict the flaw growth. Luna Innovations Incorporated has developed a high resolution ultrasonic instrument that can enhance the integrity of critical hardware by measuring changes in the stress state in a material. Knowledge of the stress state plus knowledge of crack sizes greatly improves structural engineers' capability of life prediction. System data will be shown for tests to stresses near holes in laboratory fabricated aircraft metal samples. Scans of the spatial distribution of stresses will be compared with finite element models of the structure.

[1]Acknowledge support from US Army.

SESSION CC THEORY, GENERAL

Williamsburg Hospitality House, Yorktown
Chair: Chris Carone (College of William and Mary)
Thursday, November 9, 2006 10:45 AM - 12:45 PM

10:45 AM

CC.00001 - Quantum spins and their approach to the classical limit, *LARRY ENGELHARDT, Francis Marion University* — We have performed Monte Carlo calculations for both quantum and classical Heisenberg spin models in an effort to study how quantum spins approach the "classical limit". This talk will include a brief review of these models and their physical consequences, as well as a summary of our most interesting results. In particular, by considering many values of the intrinsic spin quantum number s, we have studied how the discrete energy spectra of (quantum) spin rings approach continuous spectra in the limits $s \to \infty$.[1] Additionally, by calculating the temperature dependence of the magnetic susceptibility for many geometries, we have also determined the temperature range over which classical spin models will accurately approximate quantum systems.[2]

[1]L. Engelhardt and M. Luban, Phys. Rev. B 73, 054430 (2006).

[2]L. Engelhardt, M. Luban, and C. Schröder, Phys. Rev. B 74, 054413 (2006).

10:57 AM

CC.00002 - Energetics and thermal transport of a Brownian heat engine in the underdamped regime.[1] *RONALD BENJAMIN, RYOICHI KAWAI*, *University Of Alabama at Birmingham* — Energetics and coherence of transport in the presence of non-uniform temperature is still an open problem. We study the same for a Brownian heat engine based on the Buttiker-Landauer ratchet model. Unlike other ratchet models where the role of inertia is not important in the study of stochastic energetics, efficiency of the Buttiker-Landauer ratchet can only be evaluated properly when inertia is taken into account. We study this system via numerical simulations and present our results.

[1]I would wish to acknowledge financial support from the GAFP (Graduate Assistantship Fellowship Program) Fellowship of the University of Alabama at Birmingham .

11:09 AM

CC.00003 - ABSTRACT WITHDRAWN

11:21 AM

CC.00004 - Radial oscillation of a gas bubble in a fluid as a problem in canonical perturbation theory, *JAMES STEPHENS, University of Southern Mississippi* — The oscillation of a gas bubble is in a fluid is of interest in many areas of physics and technology. Lord Rayleigh treated the pressure developed in the collapse of cavitation bubbles and developed an expression for the collapse period. Minnaert developed a harmonic oscillator approximation to bubble oscillation in his study of the sound produced by running water. Besides recent interest in bubble oscillation in connection to sonoluminescence, an understanding of oscillating bubbles is of important to oceanographers studying the sound spectrum produced by water waves, geophysicists employing air guns as acoustic probes, mechanical engineers concerned with erosion of turbine blades, and military engineers concerned with the acoustic signatures developed by the propeller screws of ships and submarines. For the oceanographer, Minnaert's approximation is useful, for the latter two examples, Lord Rayleigh's analysis is appropriate. For the case of the airgun, a period of twice Rayleigh's period for the "total collapse" of the cavitation bubble is often cited as a good approximation for the period of an air bubble ejected from an air gun port, typically at ~2000 psi), however for the geophysical example, numerical integration is employed from the outset to determine the dynamics of the bubble and the emitted acoustic energy. On the one hand, a bubble can be treated as a harmonic oscillator in the small amplitude regime, whereas even in the relatively moderate pressure regime characteristic of air guns the oscillation is strongly nonlinear and amplitude dependent. Is it possible to develop an analytic approximation that affords insight into the behavior of a bubble beyond the harmonic approximation of Minnaert? In this spirit, the free radial oscillation of a gas bubble in a fluid is treated as a problem in canonical perturbation theory. Several orders of the expansion are determined in order to explore the dependence of the oscillation frequency with bubble amplitude. The expansion to second order is inverted to express the time dependence of the oscillation.

11:33 AM

CC.00005 - Chaotic Escape of Specularly Reflecting Rays From a Vase-shaped Cavity[1], *JAISON NOVICK, JOHN DELOS, College of William and Mary, KEVIN MITCHELL, University of California Merced* — We study the escape of rays from a two dimensional, specularly reflecting open cavity having the shape of a vase. At the narrowest point of the neck of the vase there is an unstable periodic orbit which defines a dividing surface between rays that escape and rays that are turned back into the cavity. We imagine a point source on the cavity wall emitting rays in all directions and we record the time to reach a detector forming the mouth of the vase. We find that the rays arrive at the detector in pulses. The escape time, as a function of the initial conditions, displays a weak self-similarity which is understood upon transformation to a suitable phase space. Here, we find that the self-similarity arises from the intersection of the initial conditions with a homoclinic tangle, which is formed by the intersections of stable and unstable manifolds emanating from the unstable periodic orbit. We present a topological theory that partially predicts the self-similarity. We conclude with an example comparing the predictions to numerical calculations.

[1]Supported by NSF

11:45 AM
CC.00006 - The Parker-Sochacki Method of Solving Differential Equations: Applications and Limitations, *JOSEPH W. RUDMIN, James Madison University* — The Parker-Sochacki method is a powerful but simple technique of solving systems of differential equations, giving either analytical or numerical results. It has been in use for about 10 years now since its discovery by G. Edgar Parker and James Sochacki of the James Madison University Dept. of Mathematics and Statistics. It is being presented here because it is still not widely known and can benefit the listeners. It is a method of rapidly generating the Maclauren series to high order, non-iteratively. It has been successfully applied to more than a hundred systems of equations, including the classical many-body problem. Its advantages include its speed of calculation, its simplicity, and the fact that it uses only addition, subtraction and multiplication. It is not just a polynomial approximation, because it yields the Maclaurin series, and therefore exhibits the advantages and disadvantages of that series. A few applications will be presented.

11:57 AM
CC.00007 - A General Relativistic Model for the Electron, *JOSEPH D. RUDMIN, James Madison University* — Electron fields are described using Parker Sockacki expansions to solve the Einstein equation. Properties of the expansions suggest why the gravitational constant is so small.

12:00 PM
CC.00008 - Long Range Simulation of Short Waves as Nonlinear Solitary Waves, *JOHN STEINHOFF, SUBHASHINI CHITTA, University of Tennessee Space Institute* — A new numerical method is described to propagate short wave solutions to the wave equation in the time domain, over indefinite distances and through regions of varying index of refraction, including multiple reflections. The method, “Wave Confinement”, can also be used to solve the Helmholtz Equation in the high frequency (Eikonal) limit, including multiple arrivals. The method involves discretizing the wave equation on a uniform Eulerian grid and adding a simple nonlinear term. This results in capturing the waves as thin surfaces that propagate as nonlinear solitary waves and remain 2-3 grid cells in thickness with no numerical spreading. These “pulses” preserve indefinitely quantities such as energy, integrated through each point on the surface, arrival time of the centroid and other desired moments. Only a simple discretized equation is solved each time step at each node. In this way, the complex logic of Ray Tracing, such as allocation of markers to each surface and interpolation as the markers separate, is avoided. With the new method, even though the surfaces can pass through each other and involve a nonlinear term, there is no interaction effect from this term on the moments, so that the linear wave equation can be simulated. This is due to the form of the difference operators.

12:21 PM
CC.00009 - ABSTRACT WITHDRAWN

12:33 PM
CC.00010 - D-branes in the QCD Vacuum, *HARRY THACKER, University of Virginia* — Recent Monte Carlo evidence for long range sign-coherent membranes of topological charge in the vacuum of pure-glue QCD is considered in the context of string/gauge duality. Witten’s holographic brane construction of four-dimensional Yang-Mills theory from type IIA string theory is reviewed. This leads to a picture of the pure-glue QCD vacuum as consisting of multiple discrete vacua separated by domain walls, a picture suggested much earlier by large-N chiral lagrangian arguments. In the holographically equivalent string theory, the topological charge membranes correspond to D6-branes, which play a fundamental role as the carriers of Ramond-Ramond charge type IIA string theory.

SESSION DA BIO/NANOPHYSICS
Invited Session
Williamsburg Hospitality House, Empire A/B — Chair: Phillip A. Williams (NASA-Langley Research Center)
Thursday, November 9, 2006 2:00 PM - 3:48 PM

2:00 PM
DA.00001 - DNA Self-assembly and Computer System Fabrication[1], *CHRIS DWYER, Duke University* — The migration of circuit fabrication technology from the microscale to the nanoscale has generated a great deal of interest in how the fundamental physical limitations of materials will change the way computer systems are engineered. The changing relationships between performance, defects, and cost have motivated research into so-called disruptive or exotic technologies and draws inspiration from systems found in biology. Advances in DNA self-assembly have demonstrated versatile and programmable methods for the synthesis of complex nanostructures suitable for logic circuitry. Several recent advances in programmable DNA self-assembly and the theory and design of DNA nanostructures for computing will be presented. The advantages of this technology go beyond the simple scaling of device feature sizes (sub-20nm) to enable new modes of computation that are otherwise impractical with conventional technologies. A brief survey of several computer architectures that take advantage of this new technology will also be presented.

[1]This research has been sponsored by the Air Force Research Laboratory, the NSF, Microsoft Research, and Agilent Technologies.

2:36 PM
DA.00002 - Hydosomes: optically trappable femtoliter containers for studying single molecular complexes, *LORI GOLDNER, NIST* — The success of single molecule (SM) techniques relies on methods to isolate and confine the biomolecule or molecular complex under study. Typical immobilization strategies currently include (1) binding or adsorbing molecules on a surface, (2) immobilization in porous materials, and more recently (3) encapsulation in a surface-tethered lipid vesicle. Here we demonstrate a new strategy for encapsulating and manipulating single molecules in optically-trappable aqueous nanocontainers that we call hydrosomes [1]. Hydrosomes have significant advantages over other immobilization or confinement strategies, in that they facilitate the study of transiently interacting molecular complexes on a single complex basis. Unlike liposomes, hydrosomes fuse on contact. The various components of a transiently interacting molecular complex can be isolated and confined in different hydrosomes, which can then be fused to form a single larger hydrosome. This larger hydrosome, which contains and confines all complex components and yet permits them to interact freely, can then be optically interrogated [2]. We present a comparison of FRET from single surface-attached RNA 16mers with FRET from single hydrosome-encapsulated RNA 16mers. Significant perturbation from the PEG tether used to immobilize the RNA on the surface is absent for the hydrosome encapsulated RNA. Our intent is to use hydrosome encapsulation and mixing to perform studies of transiently interacting RNA/protein complexes, and two examples will be discussed.

[1] Helmerson, K. et al. Optical manipulation of nanocontainers for biotechnology. Dholakia, K and Spalding, GC. Optical Trap-ping and Optical Micromanipulation(5514). 2004. Proc. SPIE.

[2] Reiner, J.E. et al. Optically trapped aqueous droplets for single molecule studies. Applied Physics Letters 89, (2006).

3:12 PM
DA.00003 - Proton Radiotherapy, *CYNTHIA KEPPEL, Hampton University / Jefferson Lab* — Proton therapy is the most precise and advanced form of radiation treatment for cancer available. Due to the characteristic Bragg peak associated with ion energy deposition, proton therapy provides the radiation oncologist with a highly exact method of localizing treatment within a patient, as compared with conventional radiation therapy using X-rays or electrons. Controlling disease and minimizing side effects are the twin aims of radiation treatment; protons enhance the opportunity for both by facilitating maximal dose to tumor and minimal dose to surrounding tissue. In the United States, five proton centers currently treat cancer patients. Hampton Roads will be home to the nation's sixth, and largest. An overview of both the treatment capability and research planned for this center will be presented.

SESSION DB RECENT ADVANCES IN HIGH ENERGY PHYSICS
Invited Session

Williamsburg Hospitality House, Jamestown — Chair: Brad Cox (University of Virginia)
Thursday, November 9, 2006 2:00 PM - 3:48 PM

2:00 PM
DB.00001 - Search for New Physics with Flavor, *STEFAN SPANIER, University of Tennessee* — In recent years, the quark-mixing angles and the CP phase in the Cabibbo-Kobayashi-Maskawa matrix have been measured with very high precision. Today, the availability of high-luminosity hadronic and electron-positron accelerators enables indirect searches for new quark generations and interactions at energies in the TeV range via rare processes involving quantum-loops. Low energy constraints for beyond Standard Model scenarios are derived from such measurements. Recent experimental results of searches in reactions involving b, c, and s-quarks will be presented.

2:36 PM
DB.00002 - Today at the Tevatron, Tomorrow at the LHC, *ROBERT HIROSKY, University Of Virginia* — This talk will give an overview of the Run2 physics program at the Fermilab Tevatron Collider highlighting recent results from the CDF and D-ZERO Collaborations. Both experiments study proton-antiproton collisions at center-of-mass energies of approximately 2 TeV and are engaged in collecting and analyzing nearly 2 orders of magnitude more data than in the previous Tevatron running periods. Current results in electroweak, top, and new physics studies, as well as prospects for the full Run2 data set will be reviewed. The Large Hadron Collider (LHC) at CERN will soon open a window to explore elementary particle physics at a new, more fundamental scale with proton-proton interactions at center-of-mass energies of 14 TeV beginning in 2008. This discussion will conclude with an introduction to the physics goals for the first run at the LHC.

3:12 PM
DB.00003 - Future directions in HEP: the LHC era and beyond, *HOWARD BAER, Florida State University* — The LHC era in high energy physics is about to begin, and we may soon be accruing data that unravels the mysteries surrounding electroweak symmetry breaking, and the nature of the Higgs boson. In addition, various data point to the possibility of weak scale supersymmetry as an integral part of physics beyond the Standard Model. At this point in time, there is a wonderful intertwining of cosmological physics and particle physics, and LHC may be helpful in unravelling the mystery of cold dark matter in the universe, and possibly shed light on dark energy. Any new physics uncovered by LHC will of course need to be studied in the precision environment of clean TeV-scale e+ e- collisions, so a case is made for the International Linear Collider, and what it might accomplish in both particle physics and cosmology.

SESSION DC NUCLEAR PHYSICS II
Williamsburg Hospitality House, Yorktown
Chair: Mark Pitt (Virginia Tech)
Thursday, November 9, 2006 2:00 PM - 4:00 PM

2:00 PM
DC.00001 - Measuring G_E^n at High Momentum Transfer, *ROBERT FEUERBACH, Thomas Jefferson National Accelerator Facility, GEN COLLABORATION, HALL A COLLABORATION* — A precision measurement of the electric form-factor of the neutron, G_E^n, at Q^2 up to 3.5 GeV^2 was recently completed in Hall A at the Thomas Jefferson National Accelerator Facility (Jefferson Lab). The ratio of the electric to magnetic form-factors of the neutron, G_E^n / G_M^n, was measured through the beam-target asymmetry $A_\perp$ of electrons quasi-elastically scattered off neutrons in the reaction $^3\vec{He}\,(\vec{e},e'n)$. The experiment took advantage of recent developments of the electron beam and target, 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 $^3\vec{He}$ 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 newly contructed neutron detector observed the released neutron. An overview of the experiment and the experimental motivation will be discussed, in particular the large range of predictions from modern calculations for G_E^n at this relatively high Q^2. Finally, the analysis progress and preliminary results will be presented.

2:12 PM
DC.00002 - Measuring the proton's electromagnetic form factors to high Q^2 via recoil polarimetry in Hall C at Jefferson Lab, *ANDREW PUCKETT, Massachusetts Institute of Technology, GEPIII COLLABORATION, MIT NUCLEAR INTERACTIONS GROUP TEAM* — The electromagnetic form factors of the nucleon, as measured in elastic electron-nucleon scattering, are of crucial interest to a wide variety of areas of current research in both theoretical and experimental nuclear and subnuclear physics. In addition to being an important component of an understanding of nucleon structure in terms of QCD (e.g. the connection between elastic form factors and Generalized Parton Distributions), empirical knowledge of the elastic form factors is an important input for the interpretation of many other experiments, particularly quasi-elastic electron and neutrino scattering. Experiment E04-108 in Jefferson Lab's Hall C will measure the ratio of the electric and magnetic form factors of the proton to high Q^2 by measuring the components of the transferred polarization in the $^1H(\vec{e},e'\vec{p})$ reaction, and is *tentatively* scheduled to take data

in the latter part of 2007. This paper will discuss the current status of preparations for the experiment, in particular the new equipment necessary to perform this measurement in Hall C. BigCal, a large solid-angle electromagnetic calorimeter consisting of 1744 lead-glass blocks, will detect the scattered electron. The Focal Plane Polarimeter for the Hall C High Momentum Spectrometer, consisting of a series of two blocks of CH_2 analyzer, each followed by a gas drift chamber, will measure the polarization of the scattered proton.

2:24 PM

DC.00003 - Qweak: A Precision Measurement of the Proton's Weak Charge, *KLAUS GRIMM[1], College of William and Mary* — The Q_{weak} experiment at Jefferson Lab aims to make a 4% measurement of the parity-violating asymmetry in elastic scattering at very low Q^2 of a longitudinally polarized electron beam on a proton target. The experiment will measure the weak charge of the proton, and thus the weak mixing angle at a low energy scale, providing a precision test of the Standard Model. Because the value of the weak mixing angle is approximately 1/4, the weak charge of the proton $Q_w^p = 1 - 4\sin^2\theta_W$ is suppressed in the Standard Model, making it especially sensitive to the value of the mixing angle and also to possible new physics. The experiment will be a 2200 hour measurement, employing: an 80% polarized, 180 μA, 1.2 GeV electron beam; a 35 cm liquid hydrogen target; and a toroidal magnet to focus electrons scattered at 8°± 2°, a small forward angle corresponding to $Q^2 = 0.03$ (GeV/c)^2. With these kinematics the systematic uncertainties from hadronic processes are strongly suppressed. To obtain the necessary statistics the experiment must run at an event rate of over 6 GHz. This requires current mode detection of the scattered electrons, which will be achieved with synthetic quartz Čerenkov detectors. A tracking system will be used in a low-rate counting mode to determine the average Q^2 and the dilution factor of background events. The theoretical context of the experiment and the status of its design are discussed.

[1]for the Qweak Collaboration

2:36 PM

DC.00004 - Reducing Backgrounds in a High Precision Measurement of the Proton's Weak Charge at Jefferson Lab[1], *K.E. MYERS, The George Washington University, Q_{WEAK} COLLABORATION* — The Q_{weak} collaboration at Jefferson Lab is developing an experiment which will precisely measure the parity violating asymmetry in elastic electron-proton scattering. This asymmetry is proportional to the proton's weak charge – the basic property which determines the proton's response to the weak interaction. The Standard Model makes a firm prediction of the proton's weak charge, $Q_w^p = 1 - 4\sin^2\theta_W$, based on how the weak mixing angle $\sin^2\theta_W$ evolves from the Z^0 pole down to low energy scales. The ultimate goal of the experiment is to determine Q_w^p with 4% combined statistical and systematic uncertainties, which in turn leads to a 0.3% measurement of $\sin^2\theta_W$. Achieving this degree of precision requires an in-depth study of the backgrounds generated and methods to reduce them. Using a GEANT3 based simulation we have identified the acceptance defining collimator, the apertures of the shielding hut, and the beamline as sources of different types of backgrounds. Quantitative estimates of these backgrounds will be presented. The possible effects of these backgrounds on the goals of the experiment and methods to reduce them without producing new backgrounds will also be discussed.

[1]Work partially supported by NSF grant PHY-0556241

2:48 PM

DC.00005 - Measurement of Q^2 for the Q_{weak} Experiment[1], *JULIETTE MAMMEI, Virginia Tech, QWEAK COLLABORATION* — The Q_{weak} collaboration proposes to make a precise measurement of the parity violating elastic electron-proton scattering asymmetry at a Q^2 of 0.03 (GeV/c)^2. A 2200 hour measurement with a 1.165 GeV, 85% polarized, 180 μA beam on a 35 cm LH_2 target will determine the proton's weak charge with $\simeq$ 4% error. In the absence of physics beyond the Standard Model, this will provide a $\simeq$ 0.3% measurement of $\sin^2\theta_W$, the weak mixing angle. In order to achieve such high precision, $\langle Q^2 \rangle$ must be determined to ±0.5%. A precision collimator will define the Q^2 acceptance of the experiment. A dedicated tracking system will determine the difference between the actual Q^2 acceptance of the experiment, which includes energy loss and radiative effects, and the simple geometrical acceptance as defined by the collimator. The tracking system will operate at reduced beam current to determine, on an event-by-event basis, the scattered electron angle and energy, interaction vertex, and the angle and position of the electron at the entrance to the main detector. This will allow the determination of $\langle Q^2 \rangle$ and the efficiency map of the main Čerenkov detector. The tracking system will also determine the "dilution factor", the contribution of non-elastic events from the target and backgrounds in the hall. This talk will present an overview of the collimator and tracking system design.

[1]Supported in part by NSF grants PHY-0320832 and PHY-0457163

3:00 PM

DC.00006 - Results on the Spin Structure of ^{3}He and the Neutron at Low Q^2, *TIMOTHY HOLMSTROM, College of William and Mary, HALL A COLLABORATION* — For the past few decades there has been a strong interest in understanding the nucleon spin structure. Sum rules, including the Gerasimov-Drell-Hearn (GDH), and moments of the nucleon spin structure functions are powerful tools for understanding nucleon structure. The goal of Jefferson Lab experiment E97-110 is to perform a precise measurement of the Q^2 dependence of the generalized GDH integral and the moments of the ^{3}He and neutron spin structure functions between 0.02 and 0.3 (GeV/c)^2 using the Hall A polarized ^{3}He target. This Q^2 range will allow us to test the dynamics of Chiral Perturbation Theory, and test the GDH sum rule by extrapolating to the real photon point for ^{3}He and the neutron. The measurement will also contribute to the understanding of nucleon resonances. The status of the data analysis will be discussed and some preliminary results will be shown.

3:12 PM

DC.00007 - Measurement of Single Target-Spin Asymmetry in Semi-Inclusive Pion Electroproduction on a Transversely Polarized ^{3}He Target, *XIAOFENG ZHU, Duke University, HALLAJ LAB COLLABORATION* — The study of transverse spin distributions and transverse spin phenomena is at the frontier of recent research activities to understand the nucleon spin structure and QCD. We plan to measure the target single spin asymmetry in the semi-inclusive deep inelastic $\vec{n}(e,e'\pi^-)X$ and $\vec{n}(e,e'\pi^+)X$ reaction with a transversely polarized ^{3}He target as an effective polarized neutron target. The transverse single spin asymmetry on the "neutron" as a function of the Collins angle and Sivers angle will be studied in the x range of 0.13 to 0.41, providing a separation between the two competing mechanisms: the chiral-even Sivers effect and the chiral-odd Collins effect, a crucial step towards extracting the quark transversity distribution. It will be the first experiment on "neutron" transversity, complementary to the HERMES measurement on proton and the COMPASS measurement on deuteron, providing constraints on the transversity distributions and Sivers functions for both u-quark and d-quark in the valence quark region. The tentative schedule for this experiment is fall of 2007.

3:24 PM

DC.00008 - Polarized Electron Beams for the Jefferson Lab Nuclear Physics Program[1], *JOSEPH GRAMES, Jefferson Laboratory* — Almost eighty percent of the present physics program at Jefferson Lab requires polarized electron beams to probe nuclear structure. The accelerator can provide beam to three experimental halls simultaneously from the same 100 kV DC electron gun and GaAs photocathode. Multiple hall operation is a key design feature of the lab that maximizes the physics output. However, multiple hall operation also imposes restrictions on users. For example, only specific beam energies can transfer the full component of longitudinal polarization from the source, as high at 85%, to multiple halls simultaneously. This talk describes the details of polarized beam delivery to experimental halls and the factors that affect beam quality, particularly those factors relevant for conducting parity violation experiments. These details will be described in context of the progress of GaAs polarized electron sources. In addition, the state-of-the-art and future prospects for higher current and beam polarization will be discussed.

[1]Notice: Authored by Jefferson Science Associates, LLC under U.S. DOE Contract No. DE-AC05-06OR23177. The U.S. Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce this manuscript for U.S. Government purposes

3:36 PM

DC.00009 - Spin-Polarizing ^{3}He at 8 atm with a frequency narrowed diode laser*, *C.W. ARNOLD, T.V. DANIELS, A.H. COUTURE, T.B. CLEGG, UNC and TUNL* — In support of measurements of spin-correlation parameters in low-energy p + ^{3}He elastic scattering, we have been working to improve our polarizer systems [1]. Polarized ^{3}He gas is commonly produced by spin-exchange with optically pumped Rb vapor. It has been shown [2], [3] that a frequency narrowed diode laser array is a relatively inexpensive way to improve polarization. Thus, we have developed such a system which employs a nominal 50 W Quintessence 25-diode laser array. In non-narrowed mode, it operates at 790 to 795 nm with a linewidth of ~2nm. We have seen up to 32 W output when this array is placed in an external optical cavity with a Littrow mounted grating to narrow the linewidth to ~0.3 nm. Using this system, we have achieved over 30% polarization in a degaussed Pyrex cell filled to 8 ATM with a 60:1 ratio of ^{3}He to N_2. This represents a 20% improvement over values obtained with our former non-narrowed 60W Optopower laser system. The improvement is thought to arise from an increase spectral power placed into the Rb D1 absorption line, and a decrease in the amount of unwanted pumping on the D2 line. Spectra and operating conditions will be discussed.

*Work supported by USDOE Grant No. DE-FG02-97ER41041

[1] T. Katabuchi et al, Rev. Sci. Instrum. 76, 033503, (2005); [2] I.A. Nelson et al, Appl Phys Lett., Vol 76 No. 11, 1356 (2000), [3] B.Chann et al, J. Appl. Phys. Vol 94, No. 10, 6980 (2003)

3:48 PM

DC.00010 - Hybrid K-Rb Spin Exchange Optical Pumping Cells for the Polarization of ^{3}He, *ALEX COUTURE, TIM DANIELS, CHARLES ARNOLD, TOM CLEGG, UNC/TUNL* — We are transitioning from polarizing ^{3}He using optical pumping cells charged with pure Rb to using a mixture of Rb and K, lean in Rb. The reason for this is the spin exchange efficiency between K and ^{3}He is an order of magnitude greater than that of Rb and ^{3}He. Also the spin exchange cross section between Rb and K is very large, which leads to a very fast rate of polarization transfer from Rb to K. Thus by optically pumping using a standard 795 nm Rb laser on a hybrid K-Rb cell, we can obtain significant improvements in spin-up time as well as improvements in overall polarization.[1] We produce hybrid pumping cells at TUNL using a filling station consisting of an oven and a turbo pumping station to bake out and pump away any impurities in the cells. The alkali metals are introduced into the pumping cells from a Y-shaped manifold with a separate retort for each alkali. We are able to determine the ratio of K to Rb in the vapor using white light absorption spectroscopy. Light from a halogen light bulb is incident upon the heated cell and enters a spectrometer beyond. We examine the relative sizes of the D1 and D2 absorption lines for the two alkali metals. We will have data comparing hybrid cells to pure Rb cells, GE-180 cells to Pyrex, and are working to obtain comparative performance data for spectrally unnarrowed and narrowed lasers. Our latest results will be reported.

[1] E. Babcock, et al. (2003) Phys. Rev. Letter Vol. 91, Num.12, 123003

SESSION EA SEARCHING FOR GRAVITATIONAL WAVES
Invited Session

Williamsburg Hospitality House, Empire A/B — Chair: Joseph Giaime (Louisiana State University and LIGO-Livingston)
Thursday, November 9, 2006 4:15 PM - 6:15 PM

4:15 PM
EA.00001 - Status of LIGO[1], *BRIAN O'REILLY, Caltech, LIGO Livingston Laboratory* — Initial LIGO is now in the middle of a Science Run, its fifth, at design sensitivity. This talk will describe the configuration and operation of the LIGO detectors, commissioning milestones on the way to design sensitivity and remaining issues which impact performance. Plans for an enhancement to the initial configuration will be briefly described.
[1]On behalf of the LIGO Scientific Collaboration

4:45 PM
EA.00002 - Astrophysical Sources, Analysis Methods and Current Results in LIGO's Quest for Gravitational Waves[1], *LAURA CADONATI, Massachusetts Institute of Technology* — The LIGO Scientific Collaboration has adopted a variety of data analysis techniques to target potential sources of gravitational waves, such as inspiraling binary systems, pulsars, transient bursts from core-collapse supernovae and the cosmological stochastic background. This talk provides an overview of these analysis methods and presents the most recent limits on the measurable rate of gravitational waves in LIGO.
[1]For the LIGO Scientific Collaboration

5:15 PM
EA.00003 - LISA[1], *GUIDO MUELLER, University of Florida* — The Laser Interferometer Space Antenna (LISA) is a joint NASA/ESA mission to detect gravitational waves (GW) in the 0.1mHz to 1 Hz range. GW in this frequency range are generated by many exciting sources. Low mass galactic binaries are among the guaranteed LISA sources. In some cases we will be able to calculate the expected GW amplitude based on optical information. Some of these binaries will even be used to verify the interferometer response. Other binaries will form a GW background which will be difficult to resolve. Extreme mass ratio inspirals like a 10 solar mass black hole falling into a super-massive black hole (SMBH) will allow LISA to measure the multipole moments of the gravitational potential of the SMBH. This is considered the test particle case of general relativity. Mergers between super-massive black holes are among the most violent processes in the universe. These mergers were relatively common in the past and helped to form the universe as we know it now. LISA will measure the merger and will also be able to predict the merger and its sky position weeks in advance. This offers the chance to point classical telescopes in all EM-bands to the merger and have simultaneous observations. LISA will measure most of these signals and probably many others often with high signal to noise ratio. LISA will consist of three spacecraft in a triangular formation with a 5 Gm (16s light travel time) baseline. Each spacecraft will house two proof masses which form the end pieces of the LISA interferometer arms. In the sensitive direction, the proof masses will freely fall inside the spacecraft and the spacecraft are steered around their proof masses shielding them from all external forces except gravity. Laser interferometer will then measure the distances between opposite proof masses with 10pm/rtHz accuracy. I will give an overview of LISA sources, event rates, technology, and status of the project.
[1]This work is supported by the NASA/OSS grant BEFS04-0019-0019

5:45 PM
EA.00004 - Advanced LIGO: Development and Status, *BRIAN LANTZ[1], Stanford University* — The proposed Advanced Laser Interferometer Gravitational-wave Observatory (Advanced LIGO) should make the detection of gravitational waves from astrophysical sources a weekly event and usher in a new era of gravitational wave astronomy. The planned observatory will be a significant upgrade to the Initial LIGO observatory, which is now operational. Advanced LIGO will comprise a set of three nominally identical interferometric detectors at the two existing LIGO installations. At the most sensitive frequency, they should be more than an order of magnitude more sensitive to gravitational wave strain than Initial LIGO, and the detection band will be extended down to 10 Hz. We describe the technology for these detectors, which includes 180 watt lasers, advanced seismic isolation systems, and quadruple pendulum suspension systems. The pendulums support 40 kg test masses and employ very high quality optical materials and coatings. The interferometers will use both power and signal recycling, allowing the detectors to be tuned with a broad-band or narrow-band response. The current schedule predicts that the first Advanced LIGO detector will begin to search for gravitational waves in 2014.
[1]For the LIGO Scientific Collaboration

SESSION EB HIGH ENERGY PHYSICS I

Williamsburg Hospitality House, Jamestown
Chair: Stefan Spanier (University of Tennessee-Knoxville)
Thursday, November 9, 2006 4:15 PM - 5:39 PM

4:15 PM
EB.00001 - Search for New Physics with Gluonic Penguin B Decays, *GIORDANO CERIZZA, MAHALAXMI KRISHNAMURTHY, University of Tennessee, Knoxville, BABAR COLLABORATION* — Charmless B-meson decays such as B → $\eta' K$ and B → ϕK are dominated by transitions into a s-quark and a gluon via internal W-quark loops. In these loops new particles and forces as e.g. predicted by supersymmetric models can contribute virtually. This provides an opportunity to detect such New Physics as deviation of CP asymmetries from Standard Model expectations and with negligible or small hadronic uncertainties. The BaBar collaboration has now accumulated more than 350 million $B\bar{B}$ events at the $\Upsilon(4S)$ resonance. To overcome the rareness of these charmless B decay final states we have reconstructed many subdecay modes and additional similar penguin decays. We present the new CP measurements in the $\eta' K$ and $\phi(K^+K^-)K$ final states. With time-dependent B-decay Dalitz plot analyses we expand the spectrum of penguin decays.

4:27 PM
EB.00002 - Search for η_b at BaBar, *XURONG CHEN, JEFFERY WILSON,WOOCHUN PARK, University of South Carolina, BABAR COLLABORATION* — We describe a search for the η_b meson using 320 fb^{-1} of data collected by the BaBar detector at the PEP-II asymmetric e+e¡ collider at SLAC. The search covers the mass range 8.5 –10.5 GeV/c^2 in inclusive $e^+e^- \to \eta_b X$ reactions, where η_b is detected in the $K^0_s K^+\pi^-$ decay mode. We use blind analysis techniques where all event selection and optimization is studied using Monte Carlo samples, and then checked with a collection of sideband data. We use an Unbinned Extended Maximum likelihood fit to develop a scanning technique which we validate using a toy MC, leading to the calculation of an upper limit on $\sigma(e^+e^- \to \eta_b X)Br(\eta_b \to K^0_s K^+\pi^-)$ as a function of mass.

4:39 PM
EB.00003 - Towards a BF and Form Factor Measurement in $D^0 \to K^{*-}e^+\nu_e$ Decays, *HONGXUAN LIU, MILIND PUROHIT* — Using data from the BaBar experiment, we study form factors in $D^0 \to K^{*-}e^+\nu_e$ decays. These form factors, which are Lorentz-invariant functions of q^2, are predicted in several models. We present preliminary results for the parameters r_2 and r_V based on roughly 300 fb^{-1} of BaBar data. The high statistics allow us to make a significant improvement over the precision of previous results.

4:51 PM
EB.00004 - Measurement of D^0 decays to $K^0\pi^0$ at Belle, *MANMOHAN DASH, Virginia Tech, BELLE COLLABORATION* — We present a measurement of the ratio of D^0 decay rates into $K^0_L\pi^0$ and $K^0_S\pi^0$ final states. This ratio can be used to disentangle the Cabibbo favored $D^0 \to \bar{K}^0\pi^0$ and doubly Cabibbo suppressed $D^0 \to K^0\pi^0$ amplitudes, and contributes to the important goal of constraining the strong phase $\delta_{K\pi}$ between $D^0 \to K^-\pi^+$ and $D^0 \to K^+\pi^-$. The measurement is based on data accumulated by the Belle detector at the $KEKB$ e^+e^- collider.

5:03 PM
EB.00005 - ABSTRACT WITHDRAWN

5:15 PM
EB.00006 - Search for CP Violation in Hyperon Decays with the HyperCP Spectrometer at Fermilab, *EDMOND DUKES, University of Virginia, HYPERCP COLLABORATION* — Searches for experimental manifestations of CP violation have born much fruit in recent years with the discovery of direct CP violation and the first evidence of CP violation outside of the neutral kaon system. Nevertheless we still know little about CP violation: its origin remains a mystery and there is little hard evidence that it is the sole province of the Standard Model. Searches for CP violation in hyperon decays offer promising possibilities as they are sensitive to certain beyond-the-Standard-Model sources that are not probed in other systems. We report on results from the HyperCP experiment, which is making high-statistics searches with data samples a thousand times larger than any previously taken, measurements that are beginning to confront beyond-the-Standard-Model theory predictions.

5:27 PM
EB.00007 - Study of $Z\gamma$ Production at the Tevatron, *JEFFERSON KIST, Duke University* — We have studied the production of Z bosons with associated high energy photons using data collected by the CDFII detector at the Tevatron. The analysis uses the reaction $p\bar{p} \to e^+e^- \gamma + X$ at $\sqrt{s}$ = 1.96 TeV with 1 fb^{-1} of integrated luminosity. Properties of these events will be discussed with an emphasis on reduction of backgrounds in the high energy photons due to hadronic jets.

SESSION EC NANOSCIENCE

Williamsburg Hospitality House, Yorktown
Chair: Seong-Gon Kim (Mississippi State University)
Thursday, November 9, 2006 4:15 PM - 6:15 PM

4:15 PM
EC.00001 - Long-range interactions and Pseudo-relativistic Phenomena in Disordered Graphene: The Zero-bias Anomaly, *WILLIAM SHIVELY, DMITRI KHVESHCHENKO, University of North Carolina at Chapel Hill* — Two-dimensional graphene creates a window into new and unusual transport phenomena, which can be in terms of the propagation of non-interacting Dirac quasiparticles (DQP). In such a system, Coulomb interactions also remain unscreened, and it is of interest how such long-ranged correlations might significantly affect DQP excitations. Using single-particle tunneling measurements, the DQP densities of states are computed analytically, in the presence of mild impurities and for energies ranging between the diffusive and the ballistic limits. Interesting interplay between the Coulomb interactions and the Dirac quasiparticles is best revealed in the ballistic regime, whereas in the diffusive limit we recover what is essentially the conventional 2DEG. The evolution of the anomalous exponent characterizing the "zero-bias" anomaly in the ballistic regime is discussed.

4:27 PM
EC.00002 - Modeling of nanoscale graphite super-lattices and its applications[1], *REZA ROCK, University of Delaware, WING TAT PONG, Materials Science and Engineering Laboratory, NIST* — The study of superlattices on graphite surfaces by scanning tunneling microscopy is hampered by the lack of a method for reproducibly creating these superlattices for laboratory study. Computer models have been used to simulate these structures using the Moire pattern mechanism as the cause for superlattices. However, it is difficult to perform quantitative analyses using this simple model because the calculated corrugation amplitude of the atomic lattice is unrealistically large compared to the amplitude of the superlattice. We made the modeling results more useful and realistic by averaging the surface profile within an optimum radius around each data point. This has the effect of simulating the finite sharpness of a tunneling tip. The averaging radius controls the ratio of the atomic corrugation to the superlattice corrugation, and can be adjusted to achieve more realistic simulation results. With this model, it is now possible to perform useful analyses on the cross sections of the model superlattices. We present analyses of the layer coefficient ideality, impact of the angle of misorientation of the top graphite layer on superlattice corrugation, attenuation factor, and coexisting superlattices.

[1]This research work was carried out in the Summer Undergraduate Research Fellowship (SURF) program at the National Institute of Standards and Technology in the summer of 2006

4:39 PM
EC.00003 - DFT study of Br and Cl Electrodeposition on Ag(100), *TJIPTO JUWONO, Florida State University, IBRAHIM ABOUHAMAD, Mississippi State University, PER ARNE RIKVOLD, Florida State University* — Ab-initio density-functional methods have been used to find the lowest energies of Br and Cl adsorbates on Ag(100) surfaces with coverages of 1/9, 2/9, 1/3, and 1/2. The supercell slab method was used to calculate the electron density distributions for each configuration. The electron transfer function, surface dipole moments, adsorbate resident charge, and lateral interaction energies were calculated and compared with results from electrochemical adsorption exeperiments. The calculated quantities are weakly dependent on the coverage, and the overall shape of electron transfer function is nearly coverage independent. The calculations also show electron sharing between neighbouring Br atoms at 2/9 coverage, reminescent of Br_2 molecules. This effect is much weaker or absent for Cl.

4:51 PM
EC.00004 - Molecular dynamics simulations of crack nucleation near nanoparticle inclusions, *JEFFERY HOUZE, BOHUMIR JELINEK, SEONG-GON KIM, Mississippi State University* — We studied nucleation of cracks near a nanoparticle embedded in a matrix under tension with molecular dynamic simulations using Modified Embedded Atom Method (MEAM) potentials for Al and Mg. Uniaxial tension was applied to an Al(fcc) matrix containing an embedded Mg(hcp) nanoparticle. The same study was performed with an Al nanoparticle embedded in a Mg matrix. Animations showing the damage evolution in both alloying situations and the effect of the materials different tensile strengths on crack nucleation will be presented.

5:03 PM
EC.00005 - Molecular Dynamics Simulation of Sintering of Nanopowders, *AMITAVA MOITRA, SUNGHO KIM, SEONG-GON KIM, Mississippi State University* — Nanopowder metallurgy is an emerging technology that fabricates sophisticated metal parts by sintering of nano-scale metal powders. Consolidated nanopowders are known to have enhanced mechanical properties compared to conventional micron-size powders. Nanopowders also offer the promise of improving the sintering process since, due to their higher surface area to volume ratio, they can be densified more fully and much quicker resulting lower sintering temperature and higher fracture toughness. To understand the fundamental mechanisms of sintering of nanopowders, molecular dynamics simulations of tungsten nano-particles were performed using the Modified Embedded Atom Method (MEAM). The effects of various heating cycles on sintering process as a function of size of the nanopowders will be presented.

5:15 PM

EC.00006 - Large Cubic Nonlinearity of Silver Nanoparticles, *S.M. MA, Q. YANG, R. BATTLE, L. CREEKMORE, B. TABIBI, J.T. SEO, Hampton University, W.J. KIM, J.H. HEO, W.S. YUN, D.H. HA, S.S. JUNG, Korea Research Institute of Standards and Science, E. BRYANT, C. PAYNE, W. YU, V. COLVIN, Rice University.* — The cubic nonlinearity of Ag nanoparticles (NPs) with average sizes of ~112 nm and ~4 nm were investigated using polarization-resolved degenerate four-wave mixing (DFWM) at the regions of non surface plasmon resonance (SPR). The absorption spectra and TEM pictures of Ag NPs with an average size of ~112 nm indicated wide morphology of size and shape distributions, and those of Ag NPs with an average size of ~4 nm provided narrow size distribution. The SPR absorption peaks of Ag NPs with average sizes of ~112 nm and ~4 nm were ~420 nm with an inhomogeneous spectral shape and ~424 nm with a homogeneous shape. The excitation source was a spatially Gaussian shaped, ~6 ns pulsed laser with 10-Hz repetition rate operating at 1064- and 532-nm wavelengths for the DFWM spectroscopy. The concentration- and polarization-resolved DFWMs revealed that the hyperpolarizabilities of Ag NPs with average sizes of ~112 nm and ~4 nm were ~1.05×10^{-20}esu and ~4.19×10^{-21}esu, and ~3.05×10^{-26}esu and ~6.6×10^{-27}esu for parallel and orthogonal polarizations. The possible origins of large hyperpolarizability enhancement with the Ag NPs with average size of ~112 nm are a dielectric resonance and edge effects of the existing nanorods and nanoplates in the NPs.

5:27 PM

EC.00007 - Automated Tracking of Nanometer-Scale Feature Evolution Using an STM, *RUSSELL LAKE, Clemson University, ADAM DEAN, College of Charleston, NIRU MAHESWARANATHAN, South Carolina Governors School for Science and Mathematics, CHAD SOSOLIK, Clemson University* — Time-resolved measurements of vacancy pits and adatom islands on monatomic metallic surfaces (e.g. Ag(111) [1]) have provided valuable insight into the underlying atomic diffusion processes that drive dynamics at nanometer length scales. Utilizing our variable temperature scanning tunneling microscope or STM, we are extending this probing method to more complex systems, such as the AuCu and NiAl alloys. To increase the rate of successful data acquisition for these measurements, we have developed automated tracking routines that allow for the continuous monitoring of evolving surface features with minimal operator involvement. Post-acquisition image analysis is further enhanced utilizing feature detection algorithms. Current proof-of-concept results spanning several hours of acquisition time on single crystal metal surfaces are presented.

[1] K. Morgenstern et al., Phys. Rev. B 63, 045412 (2001).

5:39 PM

EC.00008 - Actuation of High-Aspect-Ratio Magnetoelastic Nanorod Arrays[1]**,** *B.A. EVANS, A.R. SHIELDS, University of North Carolina at Chapel Hill Department of Physics, R.L. CARROLL, University of West Virginia Department of Chemistry, R. SUPERFINE, University of North Carolina at Chapel Hill Department of Physics* — Nanoscale arrays of actuable rods may have applications as nanoscale mechanical stirrers for microfluidics systems, mechanical actuators, or active antibiofouling surfaces, and may produce interesting photonic effects. In addition, our group is interested in using such nanorod arrays as a model for biological cilia, in order to study fluid flow and mucociliary clearance in the human lung. We have produced nanorod arrays both by lateral self-assembly of metallic rods and by templation of a curable magnetoelastomer. Paramagnetic rods respond to torque applied by magnetic fields and forces applied by magnetic field gradients. We have developed an energy-minimization model which inputs the magnetic, geometric, and elastic properties of our rod arrays and calculates the degree of bending due to magnetic effects. The spatial modulation of 30 microns in the actuation of biological cilia presents a challenge in designing actuating fields for our biomimetic model. We will present a strategy based on our mathematical model to produce spatial modulation of this magnitude in our nanorod arrays.

[1]NIH P41-EB002025, NIH RO1-EB000761, NSF CMS-0507151.

5:51 PM

EC.00009 - The Functionalized Double-Walled Nanotube, *S.J. FRANKLAND, National Institute of Aerospace, G.M. ODEGARD, Michigan Technological University, T.S. GATES, NASA Langley Research Center* — Functionalized nanotube materials are being proposed as fillers in polymer matrix materials for aerospace applications. Chemical modification (functionalization) of nanotubes enables better association with the polymer, but in doing so, changes in the molecular structure of the nanotube. In functionalized double-walled nanotubes (f-DWNT), the outer nanotube is made compatible with the polymer while the inner nanotube is pristine. In the present work, molecular dynamics (MD) simulation and the equivalent continuum method are used to calculate mechanical properties of f-DWNTs. Young's moduli have been calculated for multiple f-DWNT systems. MD simulations also demonstrate that the f-DWNT have friction coefficients on the order of one reducing the degree of nanotube slippage in a composite. The paper will present results for the Young's modulus and friction coefficients of f-DWNT systems.

6:03 PM

EC.00010 - Tuning Silicon Photonic Crystal Band Gap by Oxidation and Etching, *MAKHIN THITSA, SACHARIA ALBIN, Old Dominion University* — Tunability of photonic bandgap is restricted by the limited number of parameters that can be varied. In triangular silicon photonic crystal consisting of silicon pillars in air background, it is difficult to fine tune the photonic band gap because the gap is too sensitive to the change in atom radius. When silicon atom is etched from the radius of 0.28*a (a = lattice constant), to 0.1* a, the TM band gap drastically changes from 0.095 to 0.16 normalized frequency value, and the midgap frequency shifts from 0.325 to 0.49. In this paper it is demonstrated that by oxidizing the silicon and etching the silicon dioxide, the band gap can be tuned in a much finer scale by varying the oxide thickness. Plane wave expansion method is used for modeling the process. In our model, when silicon pillars are oxidized so that silicon is consumed and silicon radius goes from 0.28*a to 0.1*a, the band gap changes very slowly from 0.095 to 0.1 and the midgap from 0.325 to 0.42. After that the silicon dioxide is etched, and the band gap and midgap frequency changes slowly with the oxide thickness. Along this path the band gap moves from 0.1 to 0.16 and the midgap frequency from 0.42 to 0.49.

SESSION FA ENERGY CHALLENGES FOR THE 21st CENTURY

Invited Session

Williamsburg Hospitality House, Empire A/B — Chair: Thomas Clegg (University of North Carolina, Chapel Hill)

Thursday, November 9, 2006 8:00 PM - 9:40 PM

8:00 PM

FA.00001 - Achieving cheap clean energy for all in the 21st Century? *RAJAN GUPTA, Los Alamos National Laboratory* — Energy is essential for modern life and is a critical resource that we take for granted. Unfortunately, we are increasingly confronted by many unsettling questions: Is there enough cheap oil and gas remaining and should we start changing our life styles towards energy efficiency? What will be the price of oil and gas next year and will we face shortages? Are rising prices reflective of greed and manipulation or geopolitics or of real constraints? Will renewable sources provide a significant fraction of our energy needs? Is global warming already happening and is it a result of our “addiction to oil”? If the answer to these is “yes”, then what can we, as individuals, do to help ourselves, the nation, and the world? This talk will attempt to answer these questions by examining the global oil, gas and other resources, emerging constraints and opportunities, and geopolitics.

8:50 PM

FA.00002 - The Peaking of World Oil Production: The Problem and Its Mitigation, *ROBERT L. HIRSCH, Senior Energy Program Adviser, SAIC* — The peaking of world conventional oil production will be unlike any energy problem yet faced by modern industrial society. Without timely mitigation, the economic, social, and political costs will be dire and unprecedented. Viable mitigation options exist on both the supply and demand sides, but to have substantial impact, they must be initiated more than a decade in advance of peaking, because the scale of liquid fuels mitigation is inherently extremely large. When world oil peaking will occur is not known with certainty. A fundamental problem in predicting oil peaking is the poor quality of, and political biases in, world oil reserves data. Some experts believe peaking may occur soon, while some think later, but not beyond the time required for effective mitigation. The problems associated with world oil production peaking will not be temporary, and past “energy crisis” experience will provide relatively little guidance. Oil peaking will create a severe liquid fuels problem primarily for the transportation sector, not an “energy crisis” in the usual sense that term has been used. While greater end-use efficiency is essential, increased efficiency alone will be neither sufficient nor timely enough to solve the problem. Production of large amounts of substitute liquid fuels will be required. A number of commercial or near-commercial substitute fuel production technologies are currently available for deployment, so the production of vast amounts of substitute liquid fuels is feasible with existing technology. Intervention by governments will be required, because the economic and social implications of oil peaking would otherwise be chaotic. The experiences of the 1970s and 1980s offer important guides as to government actions that are desirable and those that are undesirable, but the process will not be easy.

SESSION GA RECENT ADVANCES IN NEUTRINO PHYSICS

Invited Session

Williamsburg Hospitality House, Empire A/B — Chair: Jeffrey Nelson (College of William & Mary)

Friday, November 10, 2006 8:00 AM - 10:00 AM

8:00 AM

GA.00001 - Results from the first year MINOS operations in the NuMI beam[1], *JEFFREY NELSON, College of William and Mary* — After a brief review of the current neutrino oscillation status, we present results from the MINOS experiment based on its initial exposure to neutrinos from the Fermilab NuMI beam. The rates and energy spectra of charged current muon neutrino interactions are compared in two detectors located along the beam axis at distances of 1 km and 735 km. With 1.27 x 10^{20} 120 GeV protons incident on the NuMI target, 215 events with energies below 30 GeV are observed at the Far Detector, compared to an expectation of 336 with an error in the expectation of 14.4 events. The data are consistent with muon neutrino disappearance via two-flavor oscillations with $\Delta m^2_{23} = 2.74^{+0.44}_{-0.26} \times 10^{-3}\ eV^2$ and $sin^2(2\theta_{23}) > 0.87$ (68% C.L.).

[1]On behalf of the MINOS Collaboration.

8:30 AM

GA.00002 - Measuring the Solar Neutrino Spectrum, *R. BRUCE VOGELAAR, Virginia Tech* — Efforts to measure the solar neutrinos spectra have already proven to be very rewarding. Neutrino oscillations have been definitely observed in the higher energy part of the spectra, and, coupled with the MSW mechanism, can explain the integral lower-energy flux measurements to date. However, there is still no direct signature that MSW oscillations are indeed the full explanation. Also, the luminosity of the Sun, as determined by its emitted photon flux, compared to its luminosity as determined by neutrino measurements, still differ by 20 to 40% at one sigma. There could be seveal reasons for this: theta-13 is non-zero, there are other sources of energy in the Sun, the photons coming from the surface of the Sun reflect an older Sun than seen with neutrinos produced only minutes ago, or perhaps some entirely new phenomena. Thus, current experiments to measure the ^{7}Be neutrino flux, in the middle of the solar spectra, are of major importance. This talk will describe the progress to date of the Borexino and KamLAND experiments designed to measure this flux. Likewise, acurately measureing the pp-neutrino flux, over 90% of the total flux from the Sun, still remains to be done. This talk will describe the upcoming experiments designed to meet this challenge and what we can expect to learn.

9:00 AM

GA.00003 - Recent Results form the MiniBooNE Experiment, *JONATHAN LINK, Virginia Tech* — The MiniBooNE experiment was designed to test the unconfirmed, large Δm^2 neutrino oscillation signal reported by the LSND experiment. MiniBooNE has been taking data since late 2001 and it now has the world's largest data set of GeV energy neutrino interactions. In addition to neutrino oscillations MiniBooNE is expected to produce ground breaking results in neutrino and anti-neutrino cross sections. I will discuss the latest results from MiniBooNE.

9:30 AM

GA.00004 - Next Generation Neutrinoless Double Beta-Decay: Probing Majorana Neutrino Masses Below the 100 meV Level[1], *ALBERT YOUNG, TUNL/NCState University* — Neutrinoless double beta-decay is a unique tool for probing the absolute mass of neutrinos and determining whether the neutrino is a Dirac or Majorana particle. Neutrino oscillation experiments have established several possible scenarios for the heirarchy of neutrino masses. We present ongoing and planned double beta-decay experiments and their potential impact on our understanding of these mass heirarchy scenarios.

[1]Work supported by the the Low Energy Nuclear Physics Division of the DOE

SESSION GB BIOPHYSICS

Williamsburg Hospitality House, Jamestown
Chair: Richard Superfine (University of North Carolina at Chapel Hill)
Friday, November 10, 2006 8:00 AM - 9:48 AM

8:00 AM
GB.00001 - Electrostatic effects on the folding stability of FKBP , *JYOTICA BATRA, HUAN-XIANG ZHOU, Institute of Molecular Biophysics and Department of Physics, Florida State University, Tallahassee, Fl-32306* — Charged residues play important roles in the folding of proteins and their interactions with biological targets. We have developed computational models for predicting electrostatic contributions to protein folding and binding stability. To rigorously test and further refine these models, we carried out experimental studies on the effects of charge mutations on the folding stability of FKBP. Two close homologues of FKBP, FKBP12 and FKBP12.6, differ in 18 of 107 positions, and 8 of which involve substitutions of charged residues. These 8 substitutions were introduced on FKBP12 and their effects on the folding stability were measured. The changes in unfolding free energy varied from -0.34 to 0.65 kcal/mol. A double and a triple mutation were introduced to accumulate the stabilization effect of individual substitutions, resulting an increase in stability of about 0.84 kcal/mol. On the other hand, neutralizing one or both partners of a conserved salt bridge reduced the stability by as much as 0.64 kcal/mol. These results suggest that charged residues can modulate the folding stability significantly. To further exploit stabilization effects of charged residues, experiments are now underway to introduce charge mutations that are modeled after a thermophilic FKBP.

8:12 AM
GB.00002 - Energy Landscape and Transition State of Protein-Protein Association, *RAMZI ALSALLAQ, HUAN-XIANG ZHOU, Physics Department, Insitute of Molecular Biophysics, School of Computational Science, Florida State University, Tallahassee, FL* — Formation of a stereospecific protein complex is favored by specific interactions between two proteins but disfavored by the loss of translational and rotational freedom. Echoing the protein folding process, we have previously proposed a transition state for protein-protein association. Here we clarify the specification of the transition state by working with two toy models for protein association. The models demonstrate that a sharp transition between the bound state with numerous short-range interactions but restricted translation and rotational freedom and the unbound state with at most a small number of interactions but expanded configurational freedom. This transition sets the outer boundary of the bound state as well as the transition state for association. The energy landscape is funnel-like, with the deep well of the bound state surrounded by a broad shallow basin. This formalism of protein-protein association is applied to four protein-protein complexes, and is found to give accurate predictions for the effects of charge mutations and ionic strength on the association rates.

8:24 AM
GB.00003 - Kinetics of Vascular Remodeling: Comparison of Solver Approaches, *R.C. WARD, ORNL, J.J. NUTARO, ORNL, K.L. KRUSE, ORNL, E.C. O'QUINN, A.R. REEDY-JACKSON, M.M. WOERNER* — Results will be presented for kinetics of matrix metalloproteinases (MMP), enzymes that play a significant role in vascular remodeling. Three different computational approaches for well-mixed kinetics processes will be analyzed and compared. The kinetics of one MMP, namely MMP2, were elucidated using a model and rate constants from published literature[1] and implemented using the *JSim* environment (see nsr.bioeng.washington.edu). Further investigations of this pathway were undertaken using System Biology Workbench (SBW) (see sbw.kgi.edu), where the system of kinetic equations was created using an interactive visual interface. Using SBW the complexity of the kinetics was evaluated using phase space analysis. Finally, we implemented the kinetics model using Discrete Event System Specification (DEVS). Using *adev* (see www.ece.arizona.edu/~nutaro), an open-source DEVS modeling environment we demonstrate that continuous, well-mixed, enzyme kinetics can be modeled using discrete event simulation. The three computational environments will be compared and their utility and comprehensiveness evaluated.

1. Karagiannis, E. D. and Popel, A. S., J. of Biological Chemistry, **279** (37):39105{39114, 2004.

8:36 AM
GB.00004 - Dynamic model of active transport: application to sodium/potassium pump, *BRIAN KEATING, ROBERT FINKEL, St. John's University* — Active transport is a process where some energetic agent, generally an enzyme powered by ATP, conveys ions across a membrane. Here we present a novel physical approach to modeling the dynamics of active transport. Specifically, we employ a general method whereby the non-equilibrium energetics of active transport derive simply from the chemical kinetic rate equations. The case treated here is an exchange of sodium and potassium ions across a cell membrane at the expenditure of one ATP—a process common to most life forms. The generic rate equations are readily formulated and only two well established quantities are input, the ATP energy value and the membrane potential. The model uses this sparse information to generate several agreements with experimental values including the relative concentrations of Na and K on either side of the membrane and the celebrated 3:2 transfer ratio of sodium to potassium.

8:48 AM
GB.00005 - Cellular Potts Models of Fruit Fly Embryogenesis, *JASON ROHNER, SHANE HUTSON, Vanderbilt University* — Biologists have extensively studied embryonic development in the fruit fly (*Drosophila melangaster*) as a model for morphogenesis. Our overall goal is to understand how the cellular rearrangements of morphogenesis are caused by the underlying forces between cells. To that end, we are developing means to replicate fruit fly embryogenesis (from cellular differentiation to dorsal closure) using cellular Potts

models. Cells are described as collections of like "spins"; and spin-spin interaction energies are used to describe the forces along cell boundaries. Using a four state (spin-type) model (three tissue types and the surrounding media) we have reproduced cell sorting as well as engulfment of a surface grouping of tissue. Cell sorting can be accomplished using only the spin-spin interaction energies with the volume components being used only for cell size management. We are currently attempting to replicate the experimentally determined geometry and dynamics of dorsal closure. This modeling will take advantage of software tools developed at Notre Dame for looking at cellular Potts models and packaged as CompuCell3D.

9:00 AM

GB.00006 - GBr^6: a Parameterization-Free, Accurate, Analytical Generalized Born Model, *HARIANTO TJONG, HUAN-XIANG ZHOU, Department of Physics and Institute of Molecular Biophysics and School of Computational Science, Florida State University, Tallahassee, Florida 32306* — The Poisson-Boltzmann (PB) equation is widely used for modeling electrostatic effects for macromolecules. Generalized Born (GB) models have been developed to mimic PB results at substantial lower computational cost. Here we report an analytical GB model that reproduces PB results with high accuracy. The analytical approach is adapted from Gallicchio and Levy (J. Comput. Chem 25:479, 2004), but we implement an improvement of the Coulomb-field approximation proposed by Grycuk (J. Chem. Phys. 119:9, 2003). Benchmarked against PB results, our GB model has an average error of only 0.5% for a representative set of 55 proteins and of 0.4% and 0.2%, respectively, for folded and unfolded conformations of cytochrome b_{562} sampled in molecular dynamics simulations. The dependencies of the electrostatic solvation free energy on solute and solvent dielectric constants and on salt concentration are fully accounted for in this model.

9:12 AM

GB.00007 - Fabrication of Magnetically Actuated Polymeric Nanorod Arrays to Mimic Biological Cilia[1], *A.R. SHIELDS, B.A. EVANS, University of North Carolina at Chapel Hill - Physics Department, R.L. CARROLL, University of West Virginia - Chemistry Dept., R. SUPERFINE, University of North Carolina at Chapel Hill - Physics Department* — We report on successful fabrication of free-standing polymer nanorod arrays capable of actuation via externally applied magnetic fields. Our primary motivation is to mimic the ability of epithelial lung cilia to promote microscale fluid transport. Additionally, nanoscale actuator arrays of this nature have a wide variety of possible applications including microfluidics, sensing, and photonics. To fabricate these structures we utilize porous polycarbonate track-etched membranes as templates for a dispersion of a magnetic nanoparticle ferrofluid in polydimethylsiloxane (PDMS). Crosslinking of the polymer followed by subsequent dissolution of the membrane releases the rod array. With this method we have successfully fabricated rods with diameters down to 200 nanometers and lengths of 10-25 microns. Rods of various sizes have been successfully actuated with permanent magnets as well as an integrated magnetic force microscope that was developed in-house. We have demonstrated that actuation induces local fluid flow and are currently developing increased control over the array's actuation pattern to more closely resemble that of biological cilia.

[1]NIH P41-EB002025, NIH RO1-EB000761, NSF CMS-0507151.

9:24 AM

GB.00008 - Spot Surface Labeling of Magnetic Microbeads and Application in Biological Force Measurements, *ASHLEY ESTES, E. TIM O'BRIEN, DAVID HILL, RICHARD SUPERFINE, University of North Carolina-Chapel Hill Department of Physics* — Biological force measurements on single molecules and macromolecular structures often use microbeads for the application of force. These techniques are often complicated by multiple attachments and nonspecific binding. In one set of experiments, we are applying a magnetic force microscope that allows us to pull on magnetic beads attached to ciliated human bronchial epithelial cells. These experiments provide a means to measure the stall force of cilia and understand how cilia propel fluids. However, because we are using beads with diameters of one and 2.8 microns, and the diameter of human airway cilia is approximately 200 nm, we cannot be assured that the bead is bound to a single cilium. To address this, we have developed a sputter coating technique to block the biotin binding capability of the streptavidin labeled bead over its entire surface except for a small spot. These beads may also have applications in other biological experiments such as DNA force experiments in which binding of a single target to an individual bead is critical.

9:36 AM

GB.00009 Positron Emission Imaging Studies of Carbon Partitioning in Plants, *M.R. KISER, C.R. HOWELL, A.S. CROWELL, Duke University Physics Department and TUNL, C.D. REID, R.P. PHILLIPS, Duke University Biology Department* — Over the past two centuries the atmospheric CO_2 concentration has increased dramatically, and climate experts predict that CO_2 levels will double by the end of this century. To understand plant responses to these global change conditions, we use short-lived radioisotope labeling techniques to trace the distribution of carbon in plants grown at ambient (350 PPM) and elevated (700 PPM) CO_2 concentrations. The plants are grown and labeled in environmental growth chambers at the Duke University Phytotron, and carbon-11 dioxide is produced at TUNL using the $^{14}N(p,\alpha)^{11}C$ reaction. The close proximity of TUNL and the Duke University Phytotron creates a unique opportunity for these global change studies. Recent experiments seek to quantify the fraction of carbon that is released from the roots either as soluble carbon in the root nutrient solution or as respired CO_2 dissolved in the nutrient solution. Preliminary results from this experiment will be presented, as well as results from single detectors

collimated to restrict the field of each detector to a specific region of the plant and development of a high spatial resolution planar positron emission imager.

SESSION GC POSTER SESSION

Williamsburg Hospitality House, Empire C
Friday, November 10, 2006 8:00 AM - 10:00 AM

GC.00001 - Problem Solving Approach: Computer vs. Textbook[1], *EVAN RICHARDS, North Carolina State University, Raleigh, NC, JEFF POLAK, University of Wisconsin at Whitewater, Whitewater, WI, ASHLEY HARDIN, Broughton High School, Raleigh, NC, MARY BRIDGET KUSTUSCH, North Carolina State University, Raleigh, NC , JOHN RISLEY, North Carolina State University and WebAssign, Raleigh, NC* — Given the abundant use of worked examples and problems as learning material in physics textbooks, it is appropriate to investigate methods of implementing them in the classroom. In particular, a version of the textbook worked examples and problems implemented on a computer with auto-grading and recording features, would allow instructors to track which students complete the computer versions. In addition, computers offer interactivity, which is not practical with the inherent constraints of the textbook implementation. This study seeks to compare student performance in solving physics problems in two separate formats: computer and textbook. Each problem was preceded by a related worked example in the same format. T-tests reveal no significant differences in mean performance between the two groups. However, error analysis denoted significant differences in the group correlations to error type, which prompted the approach analysis to be undertaken. The results of this study will be presented.

[1]Funded in part by Advanced Instructional Systems, the provider of WebAssign

GC.00002 - Rayleigh Scattering, *R. SETH SMITH, Francis Marion University* — The scattering experiment is one of the most widely used techniques in physics for understanding the nature of the microscopic world. This work describes a scattering experiment suitable for use with undergraduates. The theory of Mie Scattering describes the scattering of light from particles of any size. However, if one confines his attention to light with a wavelength that is significantly larger than the particle size, the scattering is described by a simpler theory known as Rayleigh Scattering. In this case, Rayleigh Scattering predicts that the intensity of the scattered radiation is inversely proportional to the fourth power of the wavelength of the light. In this experiment, visible light (500-600 nm) from a tunable dye laser is incident on a sample of latex microspheres with a diameter of 30 nm. The scattered light intensity is monitored with a photomultiplier tube and plotted as a function of laser wavelength. The details of the experiment setup and plots of the results will be presented.

GC.00003 - A two-state quantum level and power analysis of event related scalp potential data relevant to the detection of deception and to the discrimination of correlates of high-order cognitive functioning. *MICHAEL SCHILLACI, University of South Carolina* — We propose a novel analysis approach for scalp potential data within a Quantum Mechanical formalism for voltage measures obtained during truthful and deceptive responses to questions regarding autobiographical information; our results not only provide independent verification for recent studies showing that surface skin temperature may improve the accuracy of traditional polygraph, but also provides an argument for the appropriateness and efficacy of the quantum-level analysis offered. Regional attenuation and cognitive activity levels for areas of neurophysiological significance are assessed and show that deceptive response-states emit between 8% and 10% less power. A time course analysis of the cognitive activity over posterior and anterior regions of the brain supports this finding suggesting that neocortical interactions reflecting differing workload demands during executive and semantic processes take longer for the case of deception.

GC.00004 - The Explanation of the Pauli Exclusion Principle, *VICTOR VASILIEV, Pr., Dr., RUSSELL MOON, Consultant* — Using the principles of the Vortex Theory,the alpha particle, and the theory that the nucleus is constructed out of alpha particles, the explanation of the Pauli Exclusion Principle is easily explained. Because protons and electrons are connected to each other via a fourth dimensional vortex, they spin in opposite directions. Since the alpha particle possesses two protons possessing opposite spins, their electrons also possess opposite spins. With a nucleus constructed out of alpha particles, all paired electrons in shells and sub-shells will spin in opposite directions. 1.R.Moon, F.Calvo, V.Vasiliev. About of the Conservation of Lepton Number, Bulletin of the APS, http://www.phys.ufl.edu/sesaps05.html 72nd Annual Meeting November10-12, 2005. Gainesville, Fla, USA, BC.00008. 2.K.Gridnev, R.Moon, V.Vasiliev. Experiment that discovered the Photon Acceleration Effect, International Symposium on Origin of Matter and Evolution of Galaxies (OMEG05), New Horizon of Nuclear Astrophysics and Cosmology, November 8-11, 2005, University of Tokyo, Tokyo, Japan, p. 77. 3. R.Moon, F.Calvo, V.Vasiliev. The Neutral Pentaquark. 2006 APS April Meeting, Dallas, TX, USA, Nuclear Theory II, Abstract 00009.

GC.00005 - Photoproduction of Neutral Kaons on Deuterons[1], *BRIAN BECKFORD, Florida International University, FLORIDA INTL. UNIVERSITY COLLABORATION, TOHOKU UNIVERSITY COLLABORATION* — Experimentation to greater understand the strangeness production mechanism can be performed by observing the electromagnetic interaction that leads to Kaon photoproduction. The n (γ, K^0) Λ reaction may assist in answering questions about the strangeness photoproduction process. An experiment into the elementary Kaon photoproduction process was investigated in an

experiment conducted at the Laboratory of Nuclear Science of Tohoku University (LNS) using the Neutral Kaon Spectrometer. (NKS). The experiment was conducted by the d (γ, K^0) reaction. K^0 will be measured in the $K^0 \rightarrow \pi^+\pi^-$ decay chain by the NKS. The NKS implements many detectors working in coincidence: These ranging from the Tagged Photon Beam generated by the 1.2 GeV Electron beam via bremsstrahlung, an Inner Plastic Scintillator Hodoscope (IH), a Straw Drift Chamber (SDC), a Cylindrical Drift Chamber (CDC), and an Outer Plastic Scintillator Hodoscope. Due to the background produced through the $\gamma \rightarrow e^+e^-$ process, electron veto counters (EV) were placed in the middle of the OH to reject charged particles in the horizontal plane of the beam line. Preliminary analysis of the data indicates the need for pulse height correction. This was achieved by analysis of the Inner and Outer hodoscopes, and determining the energy deposit in the scintillators.

[1]Research was supported by a NSF grant.

GC.00006 - Search for the pentaquark partners: $\sum^0$, N^0 and Θ^{++} , *YI QIANG, Massachusetts Institute of Technology, JLAB HALL A COLLABORATION, E04-012 COLLABORATION* — In 1997 based on chiral soliton model a narrow exotic state, $\Theta^+(1540)$, which has quark component $uudd\bar{s}$, was predicted in a $SU(3)_F$ antidecuplet of pentaquarks. If such state exists, other members of the antidecuplet could be expected to have sufficiently narrow widths to be observed as well. The Jefferson Laboratory experiment E04-012 focused on the search for $\sum^0$ and N^0 partner states in the missing mass spectra of the $H(e,e'K^+)X$ and $H(e,e'\pi^+)X$ channels. In addition, if the Θ^+ has non-zero isospin then a hypothetical isospin partner, Θ^{++}, might be expected in the $H(e,e'K^-)X$ channel which was also studied. The experiment was performed in Hall A at Jefferson Lab using a 5 GeV CW electron beam incident on a liquid hydrogen target. The two high resolution spectrometers were coupled to septum magnets to get 6 degrees' forward angles. Kaons were identified using a combination of a ring-imaging Cherenkov detector and two aerogel Cherenkov counters. The missing mass resolution was determined to be 3.5 MeV FWHM using neutron, $\Lambda(1116)$ and $\sum(1193)$ productions and provided a high sensitivity to narrow resonances. A precise measurement of the $\Lambda(1520)$ resonance has also been conducted for a cross-section comparison. As a result, no significent narrow structures were observed in any of the three channels so a Feldman-Cousins approach was used to determine the 90% confidence interval.

GC.00007 - A study on the reflectivity of Tyvek, *ALVARO CHAVARRIA, Duke University* — Tyvek is a permeable, strong, white material made by Dupont. Due to its high reflectivity, many physics experiments use Tyvek to increase the collection of light. The Super-Kamiokande neutrino experiment in Japan uses this material extensively in its outer detector and its reflective properties are part of the Super-K Geant3 Monte Carlo simulation. Currently, the reflective properties of Tyvek that are in the Super-K simulation are not precisely known. Thus, a good way to improve the outer detector (OD) simulation might be to implement a more realistic model for the reflection of photons on the Tyvek surface. An experiment was developed to measure the reflectivity (percentage of light reflected at a particular angle for a particular angle of incidence of the incoming photons) of Tyvek under water, for all angles of incidence and all angles of reflection. Preliminary results have been obtained and will be presented at the conference. Once all results are in, it will be attempted to fit the reflectivity function to Lambert's cosine law or some variation of it. After a successful experimental fit is found, the model will be implemented into Super-K's Monte Carlo simulation.

GC.00008 - Measuring scintillation light using Visible Light, *ALVARO CHAVARRIA, Duke University* — A new search for the neutron electric dipole moment (EDM) using ultra cold neutrons proposes an improvement on the neutron EDM by two orders of magnitude over the current limit (to 10^{-28} e*cm). Detection of scintillation light in superfluid ^{4}He is at the heart of this experiment. One possible scheme to detect this light is to use wavelength-shifting fibers in the superfluid ^{4}He to collect the scintillation light and transport it out of the measuring cell. The fiber terminates in a visible light photon counter (VLPC). VLPCs are doped, silicon based, solid state photomultipliers with high quantum efficiency (up to 80%) and high gain (≈40000 electrons per converted photon). Moreover, they are insensitive to magnetic fields and operate at temperatures of ≈6.5K. A test setup has been assembled at Duke University using acrylic cells wrapped in wavelength-shifting fibers that terminate on VLPCs. This setup is being used to evaluate the feasibility of this light detection scheme. The results obtained in multiple experiments done over the past summer (2006) and the current status of the project will be presented at the conference.

Reference:

A New Search for the Neutron Electric Dipole Moment, funding preproposal by the EDM collaboration; R. Golub and S. Lamoreaux, Phys. Rep. 237, 1 (1994).

GC.00009 - Behavior of Pulsed and Continuous-Wave Optical Dipole Force Traps, *M. SHIDDIQ, E.M. AHMED, M.D. HAVEY, C.I. SUKENIK, Department of Physics, Old Dominion University, Norfolk, VA, R.R. JONES, Department of Physics, University of Virginia, Charlottesville, VA, D. CHO, Department of Physics, Korea University, Seoul, Korea* — To date, almost all far-off-resonance traps (FORT) for confining ultracold atoms have used continuous-wave (cw) laser light. Recently, in addition to studies of a cw FORT, we have been investigating the behavior of a pulsed FORT constructed using a mode-locked Nd:YAG laser with 100 picosecond pulses. Both FORTs are loaded from a rubidium magneto-optical trap (MOT). For cw and pulsed traps of equal average power, we will present a quantitative side-by-side comparison of the trap loading and holding dependence on such quantities as MOT intensity and detuning, MOT hyperfine repumper laser intensity, loading

time, and FORT power. We have found that although the pulsed and cw traps behave similarly in most respects, there is a notable difference in dependence on MOT laser detuning during FORT loading. We will also present preliminary spectroscopic data of atoms confined in both the cw and pulsed FORTs. Finally, we will discuss progress on implementing the free electron laser (FEL) at Jefferson Lab to make an optical trap for atomic physics and cold chemistry applications with a well depth several orders of magnitude greater than achievable with a typical table-top laser. Supported in part by the National Science Foundation, Jefferson Laboratory, and Old Dominion University.

GC.00010 - Measurement of Intensity-Dependent Trap Loss in a Rb-Ar* MOT, *M.K. SHAFFER, C.I. SUKENIK, Department of Physics, Old Dominion University, Norfolk, Virginia* — We have measured the intensity dependence of the inter-species trap loss rate coefficients in collisions between ultracold rubidium (Rb) and ultra-cold metastable argon (Ar*) simultaneously confined in a dual species magneto-optical trap (MOT). Using a modified residual gas analyzer as a quadrupole mass spectrometer, we identify both heteronuclear Penning ionization and heteronuclear associative ionization as trap loss mechanisms. We have also made trap loss measurements in the Ar* MOT alone, where both Penning and associative ionization are observed as well. We will present our findings and discuss ongoing and future studies of the interaction between Rb and Ar* at ultracold temperatures. Support provided by the National Science Foundation and the Office of Naval Research.

GC.00011 - Driven Microbead Rheology of Fibrin Gels, *R.C. SPERO, B. SMITH, J. CRIBB, T.E. O'BRIEN, S.T. LORD, R. SUPERFINE, University of North Carolina at Chapel Hill* — The rheological properties of fibrin, the primary structural element in blood clots, have been widely studied at the macroscopic level, because its mechanical properties are critical to its physiological function. Microbead rheology (MBR) shows promise for advancing this field in various ways. First, MBR can be performed on small sample quantities (~1 uL), which is useful for high-throughput experimentation; second, fibrin's complex structure has a range of length scales, such that large cells may not propagate while small viruses diffuse easily through the mesh. Microbeads from 10 um to under 500 nm can probe these length scales. These characteristics suggest MBR could be useful in screening drugs for disorders involving variant clot rigidity. We report on efforts to measure the rheology of fibrin gels over the course of its polymerization. A magnetic force microscope applies pulsed forces to microbeads suspended in fibrin gels. Beads are monitored on an inverted microscope and their positions tracked by software over the 30-minute course of the gelation. A single mode Jefferies model is used to extract viscosity and elasticity from the beads' creep-recovery.

GC.00012 - QCM Studies of Alcohols as Vapor Phase Lubricants for MEMS, *HEATHER NEMETZ, JON JONES, TONYA COFFEY, Appalachian State University, DEPT. OF PHYSICS AND ASTRONOMY TEAM* — The future of nanotechnology depends in part upon the development of successful lubrication for micromachines (MEMS). Atomic Force Microscopy (AFM) research at Pennsylvania State University* has suggested alcohols such as propanol, ethanol, butanol, and pentanol to be potential vapor phase lubricants for MEMS; propanol at its vapor pressure can greatly reduce the friction on silicon dioxide surfaces. Due to the relatively high vapor pressure of these alcohols, all surfaces of a MEMS, including buried interfaces not easily reached by solid coatings, should become coated in thin layers of the alcohol upon exposure. We are testing the ability of the alcohols to migrate to buried interfaces in the MEMS. The mass uptake of the alcohols will be measured using the quartz crystal microbalance (QCM) in a vacuum chamber. The resonant frequency of the QCM drops as alcohols adsorb on its face. The uptake of the alcohols is measured as the pressure increases using different geometries of the cans, allowing us to simulate a buried interface. The aforementioned alcohols are first thermally distilled, then leaked into the chamber until vapor pressure of the alcohol is reached. We see significant mass uptake even in extreme geometries, where the entire QCM face is only accessible through a tiny hole in the can encasing the QCM, 0.0006" in diameter. *K. Strawhecker et al.,Trib. Lett. 19, 17 (2005).

GC.00013 - Modification of Bulk Nb Surfaces Using Ar/BF_3 and Ar/Cl_2 Plasmas[1], *M. RASKOVIC, S. POPOVIC, L. VUSKOVIC, Department of Physics, Old Dominion University, Norfolk, VA 23529* — In-situ plasma treatment is one of the promising methods for preparation of Nb surface in superconducting radio-frequency cavities. The aim of our work is to remove Nb oxides and other poor superconductors from the bulk niobium surface and to eliminate surface roughness. Since Nb forms volatile fluorides and chlorides, reactive gas mixture can contain fluoride and/or chloride based gases. We exposed the Nb surface to Ar/Cl_2 reactive gases mixture in the microwave cavity discharge system [1] and to Ar/BF_3 in the repetitively pulsed d.c. diode system [2]. Optical and mass spectrometry methods were employed for process monitoring during the surface exposure to the discharges. Treated surfaces were characterized with optical microscope, scanning electron microscope, and scanning probe microscope. The preliminary studies on the planar samples show improvement of the surface smoothness comparing to buffered chemical polishing method, currently in use. Further, the gas-phase kinetics study of both discharges used in our work is being performed. These results will be compared with the process diagnostics data in order to develop better understanding of the surface modification processes. The results will be presented at the conference. [1] M. Raskovic, et al., Proc. EPAC 2006, Edinburgh, Scotland, MOPCH184. [2] S. Radovanov, et al., J. Appl. Phys. **98**, 113307 (2005).

[1]Supported by DOE

GC.00014 - Stationary Shock Wave Structures in a Microwave Flowing Afterglow, *D.J. DRAKE, J. UPADYAY, S. POPOVIC, L. VUSKOVIC, Department of Physics, Old Dominion University, Norfolk, VA 23529* — To understand the interaction between an acoustic shock wave and a weakly ionized gas, many experiments [1, 2] have been performed in recent years. There are several approaches where this interaction can manifest itself, such as the enhancement of optical radiation, plasma-induced shock dispersion and acceleration, shock wave induced double electric layer, and localized increase in electron temperature and density. Our experiments with acoustic shock waves and weakly ionized gases were performed in a supersonic microwave flowing afterglow in which was placed a model of generic geometry. Oblique shock parameters were evaluated exactly for the given geometry that was usually spherical. We observed an enhancement in the optical radiation across the shock layer, which coincided with the calculated standoff distance. We studied the stationary shock structure using the 4p excited state populations of argon, measured using absolute emission spectroscopy. Additionally, we studied the shock structure using higher energy states (4d, 6s). Interpretation of the results will be presented at conference.

[1] S. Popovic, L. Vu·skovic, Phys. Plasmas **6** (1999) 1448.

[2] P. Bletzinger, B. N. Ganguly, A. Garscadden, Phys. Plasmas **7** (2000) 4341.

GC.00015 - Electron Impact Ionization of Heavier Ions including relativistic effects, *B.C. SAHA, Department of Physics, Florida A&M University, A.K.F. HAQUE, M.A. UDDIN, A.K. BASAK, Department of Physics, University of Rajshahi, Rajshahi, Bangladesh* — The demands of the electron impact ionization cross sections in diverse fields are enormous. And this is hard to fulfill either by experimental or *ab initio* calculations. So various analytical and semi-classical models are applied for a rapid generation of ionization cross sections accurately. We have applied a modified version [1] of the Bell et. al. equations [2] including both the ionic and relativistic corrections. In this report we show how to generalize the MBELL parameters for treating the orbital quantum numbers nl dependency; the accuracy of the procedure is tested by evaluating cross sections for various species and energies. Detail results will be presented at the meeting.

[1] A. K. F. Haque, M. A. Uddin, A. K. Basak, K. R. Karim and B. C. Saha, Phys. Rev. A73, 052703 (2006).

[2] K. L. Bell, H. B. Gilbody, J. G. Hughes, A. E. Kingston, and F. J. Smith, J. Phys. Chem. Ref. Data 12, 891 (1983).

GC.00016 - Magnetic Properties of the Insulating Lower Dimensional Mixed Magnet Mn/Ni Dichloride Monohydrate[1] , *G.C. DEFOTIS, T.M. OWENS, W.M. MAY, J.H. BOYLE, E.S. VOS, Y. MATSUYAMA, A.T. HOPKINSON, College of William and Mary* — This new mixed magnet is composed of the lower dimensional insulating magnets Mn dichloride monohydrate and Ni dichloride monohydrate, both studied previously by us. Each is a quasi-one-dimensional Heisenberg system with antiferromagnetic ordering appearing near 2.17 K (Mn system) and 5.6 K (Ni system) due to interchain exchange. The mixed system has been prepared and studied across the complete composition range. High temperature magnetic susceptibilities are analyzed to yield Curie and Weiss constants of mixtures. Analysis of the composition dependence of the Weiss constant implies that unlike-ion exchange interactions are comparable to like-ion interactions and are ferromagnetic. The temperature and composition dependence of magnetization isotherms is also examined. Most notable is the dependence of the magnetic susceptibility on temperature and composition. The kind of maxima seen for the pure components do not appear in mixtures, though sometimes subtler features can be identified. This behavior, across the entire composition range, seems to be unprecedented. Presumably disorder resulting from mixing, along with the lower dimensional character, is strong enough that magnetic long range order does not occur.

[1]Supported by NSF-SSC Grant No. DMR-0085662 and by an ACS-PRF grant.

GC.00017 - Mid-Infrared Emission from Sensitized Pr^{3+} in the Low Phonon-Energy Host KPb_2Cl_5 , *ALTHEA BLUIETT, Elizabeth City State University, EI BROWN, UWE HOMMERICH, Hampton University, SUDHIR TRIVEDI, Brimrose Corporation of America* — Energy transfer from Yb^{3+} to Pr^{3+} was explored in the low-phonon energy host KPb_2Cl_5 for 4-5 μm solid-state laser development. The incorporation of two rare-earth (RE) ions in a low-phonon energy host is expected to increase critical laser parameters such as pump efficiency and emission intensity through energy transfer. Moreover, incorporating the RE ions in a low phonon-energy host is expected to reduce the detrimental effects of non-radiative decay through multi-phonon emission. Evidence of efficient energy transfer was observed in $Yb^{3+} \rightarrow Pr^{3+}$ under 980 nm laser excitation. This was accomplished by exciting the $^3H_4 \rightarrow {}^1G_4$ absorption transition of Pr^{3+} at 980 nm in singly doped Pr: KPb_2Cl_5 and the $^2F_{7/2} \rightarrow {}^2F_{9/2}$ absorption transition of Yb^{3+} at the same excitation wavelength in the Pr, Yb: KPb_2Cl5 sample. The integrated emission intensity of Pr^{3+} in the co-doped sample is nearly 11 times larger relative to Pr^{3+} in the singly doped sample. This suggests that energy transfer between Yb and Pr was successful.

GC.00018 - Synthesis and Spectroscopic Properties of Neodymium doped Lead Chloride, *EI BROWN, UWE HOMMERICH, Hampton University, SUDHIR TRIVEDI, Brimrose Corporation of America, JOHN ZAVADA, US Army Research Office* — Recently, great attention has been focused on the development of new solid-state laser materials for potential near infrared (NIR) and middle-infrared (MIR) laser applications. Lead halide based materials have recently emerged as new non-hygroscopic laser hosts with low maximum phonon energies. The low-phonon energies lead to small non-radiative decay rates and efficient infrared emission from rare earth dopants. In

this work, the crystal growth and infrared spectroscopic properties of Nd doped lead chloride, $PbCl_2$, are discussed. Following optical pumping at 753 nm and 808 nm, Nd:$PbCl_2$ exhibited several near-infrared emission bands between 800 and 1600 nm as well as a broad MIR emission centered at 5.1μm ($^4I_{11/2} \rightarrow {}^4I_{9/2}$). The optical absorption, Judd-Ofelt (JO) parameters, and spontaneous emission probabilities of several Nd^{3+} transitions have been measured and calculated. Based on the JO analysis, the radiative quantum e±ciency of the 5.1μm emission was determined to be ~ 13 %. The peak emission cross-section of 5.1μm emission was estimated to be ~$0.4x10^{-20}cm^2$, which is comparable to the other infrared laser transitions.

GC.00019 - Magnetic Ordering Temperature Dependence on Dilution in a 3D-XY Ferromagnet[1], *G.C. DEFOTIS, W.M. MAY, T.M. OWENS, R.A. HUDDLESTON, B.R. ROTHERMEL, J.H. BOYLE, E.S. VOS, Y. MATSUYAMA, A.T. HOPKINSON, College of William and Mary* — The rare 3D-XY insulating ferromagnet Fe(III) bis(diselenocarbamate) chloride has been diluted with diamagnetic Zn(II) bis(dithiocarbamate), to the extent 3.6%, 7.9%, 13.7% and 20.2% in a series of mixtures. Since such magnetic systems are rare, and since the iron material is also a molecular ferromagnet of quite unusual type, the dilution dependence of the ordering characteristics is of considerable interest. Analysis of susceptibility and magnetization data on the several compositions yield the dilution dependence of the magnetic ordering temperature over a fairly broad range of composition. Below 10% dilution the relative decrease in the ordering temperature is much smaller than seen in most dilute systems or in theoretical calculations. At 13.7% dilution the rate of relative decrease of the ordering temperature is much increased, but the ordering temperature itself is only 10.6% below that of the pure system. Near 20% dilution a slight flattening of the ordering temperature vs composition curve appears. Behavior of this general qualitative type has been seen in certain materials previously. But the numerical details of relative variation of ordering temperature with dilution seen here are quite different from prior examples.

[1]Supported by NSF-SSC Grant No. DMR-0085662 and by an ACS-PRF grant.

GC.00020 - Electric Field Effects on Quasi 1D Organic Conductor $(TMTSF)_2PF_6$, *EDEN STEVEN, University of Wisconsin - Madison, ERIC JOBILIONG, JAMES BROOKS, National High Magnetic Field Laboratory / Florida State University* — We present a study of the behavior of the 1-D organic conductor, $(TMTSF)_2PF_6$, under electric field. We observed a dependence of the conductivity, critical temperature (at which the spin density wave effect occurs, TSDW), and magnetoresistance with the applied electric field. The conductance of the sample in the low temperature range (less than T_{SDW} = 12 K) is observed to be increasing with the applied electric field. The T_{SDW} appears to decrease with increasing electric field. The magnetoresistance behavior changes from positive to negative when higher electric field is applied. All these three dependences are ambipolar.

GC.00021 - SUSY Relics in Ordinary QCD[1], *PATRICK KEITH HYNES, HARRY THACKER, University of Virginia* — Recent work by Armoni, Shifman and Veneziano suggests that in the large N-color limit, N=1 Supersymmetric Yang-Mills Theory (SYM) is equivalent to 1-flavor QCD. In this proposed equivalence the massless gluino sparticle in the adjoint representation of SYM becomes a quark in the antisymmetric representation of 1-flavor QCD, while the gauge field and gauge couplings remain unchanged. One consequence of such an equivalence is that the scalar and pseudoscalar mesons of 1-flavor QCD should have degenerate mass, since they originate within the same Wess-Zumino supermultiplet of SYM. We use previously published lattice results to compare the masses of scalar and pseudoscalar mesons in 1-flavor QCD. We also perform a similar flavor singlet meson mass comparison in the CP(3) model.

[1]This work was supported in part by the U.S. Department of Energy under grant DE-FG02-97ER41027.

SESSION HA JEFFERSON LAB: PLANS FOR THE FUTURE

Invited Session

Williamsburg Hospitality House, Empire A/B — Chair: Anthony W. Thomas (Thomas Jefferson National Accelerator Facility)

Friday, November 10, 2006 10:15 AM - 12:03 PM

10:15 AM

HA.00001 - Overview of the 12GeV Upgrade at Jefferson Lab, *ALLISON LUNG, Thomas Jefferson National Accelerator Facility* — In February of this year the Secretary of Energy announced CD-1 for the 12 GeV Upgrade at Jefferson Lab. I will describe the key elements of this Upgrade, as well as the progress made thus far. As this project will enable major advances in our understanding of the strong force, I will also describe a sample of the key experimental measurements which we intend to carry out in the first five years of operation.

10:51 AM

HA.00002 - Tomography of the Proton. *LATIFA ELOUADRHIRI, Thomas Jefferson National Accelerator Facility* — The discovery of the Generalized Parton Distributions (GPDs) in the mid 1990's is revolutionizing our way of thinking about the intrinsic structure of the proton. Previously, the structure of the proton was studied through its charge and current distribution in exclusive and elastic electron scattering described by electromagnetic and electroweak form factors, and independently through parton distribution functions obtained in deep inelastic inclusive processes. The profound relationship between these orthogonal descriptions of the proton was hidden due to the lack of a framework that would connect these descriptions in a theoretically consistent way. The GPDs provide a transparent description of this connection, and opened up a new avenue of research that will bring us closer to the ultimate goal of determining the proton's wave function. The concept of GPDs will be introduced at an elementary level from an experimentalist's perspective, and the first pioneering measurements, such as deeply virtual Compton scattering, will be discussed. These experiments are an important first step in getting access to these new distribution functions. Finally, an outlook at the future of this new area of fundamental research at the energy-doubled CEBAF electron accelerator at Jefferson Lab will be presented.

11:27 AM

HA.00003 - Mapping the Spectrum of Gluonic Excitations with Photons: The GlueX Project at Jefferson Lab, *ALEX DZIERBA, Indiana University/Jefferson Lab* — Understanding the confinement of quarks and gluons in QCD requires an understanding of the soft gluonic field { the clearest experimental manifestation of which is the spectrum of exotic hybrid mesons. These exotic mesons carry J^{PC} quantum numbers that are not possible for a simple quark − antiquark bound state but are possible when the gluonic degrees of freedom are included. There are tantalizing indications from existing data that exotic mesons do indeed exist but a mapping of their spectrum requires high quality data with a probe that is more likely to produce exotic hybrids. The GlueX detector design is optimized for the amplitude analyses to identify these states in multiple decay modes. It will also use a linearly polarized 9 GeV photon beam. Indeed, photons are expected to particularly efficient at producing exotic hybrids but to date photon beams of sufficient quality (flux, degree of polarization, spot size) have not been possible. The 12 GeV upgrade of the CEBAF accelerator at JLab, along with the construction of a new beam line and experimental hall (Hall D) to house the GlueX detector will provide the data needed to carry out this mapping of the exotic hybrid spectrum. The first two years of data-taking will result in a data set that exceeds existing data from photoproduction by several orders of magnitude. This talk will review the current experimental information on exotic mesons and the GlueX project goals and status.

SESSION HB GRAVITY/ASTROPHYSICS

Williamsburg Hospitality House, Jamestown
Chair: Guido Mueller (University of Florida)
Friday, November 10, 2006 10:15 AM - 12:03 PM

10:15 AM

HB.00001 - The LISA benchtop simulator at the University of Florida[1], *JAMES THORPE, RACHEL CRUZ, SRIDHAR GUNTAKA, GUIDO MUELLER, University of Florida* — The Laser Interferometer Space Antenna (LISA) is a joint NASA-ESA mission to detect gravitational radiation in space. The detector is designed to see gravitational waves from various exciting sources in the frequency range of 3×10^{-5} to 1 Hz. LISA consists of three spacecraft forming a triangle with 5×10^{9} m long arms. The spacecraft house proof masses and act to shield the proof masses from external forces so that they act as freely-falling test particles of the gravitational radiation. Laser interferometry is used to monitor the distance between proof masses on different spacecraft and will be designed to see variations on the order of 10 pm. Pre-stabilization, armlocking, and time delay interferometry (TDI) will be employed to meet this sensitivity. At the University of Florida, we are developing an experimental LISA simulator to test aspects of LISA interferometry. The foundation of the simulator is a pair of cavity-stabilized lasers that provide realistic, LISA-like phase noise for our measurements. The light travel time between spacecraft is recreated in the lab by use of an electronic phase delay technique. Initial tests of the simulator have focused on phasemeter implementation, first-generation TDI, and arm-locking. We will present results from these experiments as well as discuss current and future upgrades in the effort to make the LISA simulator as realistic as possible.

[1]NASA/OSS: BEFS04-0019-0019

10:39 AM

HB.00002 - Probing the Universe on the Largest Possible Scales with Remote Cosmic Microwave Background Quadrupole Observations[1], *EMORY BUNN, University of Richmond* — Observations of cosmic microwave background (CMB) anisotropy suggest the possibility that the Universe is not statistically isotropic — that is, that it has a preferred direction — but the statistical significance of these claims is controversial. To settle the question we need an independent data set probing the same physical scales. Scattering of CMB radiation in galaxy clusters may provide the information we need: it produces a polarization signal proportional to the CMB quadrupole anisotropy at the cluster's location and look- back time, thus probing ultra-large-scale perturbations. I will present calculations of the number of independent modes that can be obtained from such a "remote quadrupole" survey, along with the length scales probed by these modes. In a sparse survey of a large area of sky, the largest-scale modes probe length scales comparable to the large- angle CMB anisotropy but with much narrower Fourier-space window functions. The formalism presented here is also useful for analyzing smaller-scale surveys to probe the late integrated Sachs-Wolfe effect and hence the properties of dark energy.

[1]Supported by NSF Grants 0233969 and 0507395

10:51 AM

HB.00003 - Search for Giant Pulses in High Edot Pul-sars, *MELISSA ILARDO, North Carolina School of Science and Mathematics, Durham, NC* — In order to investigate a possible correlation between the Edot of a pulsar and the presence of giant pulses, we made observations of pulsars J1930+1852, B1951+32 and J1913+1011 using the WAPP (Wideband Arecibo Pulsar Processor) at the Arecibo Observatory. We chose these pulsars because they possess high Edots, a characteristic shared by the Crab Pulsar, PSR B1937+21, PSR B0540-69 and B1821-24; four of the few currently known giant pulse emitters. Although no giant pulses were positively identified, PSR J1913+1011 showed enough possible evidence to warrant further research.

11:03 AM

HB.00004 - Modeling the Galaxy's Rotation Curve, *DANIEL SERRANO, J. HASBUN, University of West Georgia* — The orbital speed of material in the Galaxy does not behave according to Kepler's 3^{rd} law. This has led astronomers to postulate the existence of Dark Matter. Dark Matter is a form of missing mass; it is basically undetected matter in the universe that is under luminous and probably quite different from ordinary matter (Comins and Kaufmann 2005). In this paper we investigate the modeling of the Galaxy's rotation curve. Our models make use of a modified version of Newton's universal law of gravitation. The idea is that we employ Gauss' Law as applied to gravitation; i.e., $\oint g \bullet \hat{n} d\vec{A} = -4\pi G \int \rho d\tau$, to obtain expressions for the orbital velocity of the material within the galaxy. While this formula is capable of obtaining Newton's universal law of gravitation for constant density ρ, it is also flexible in that the density can be a variable. The variability in the density ρ is studied to investigate the fluctuations present in the experimental rotation curve. Six models are presented for this purpose: (a) The Exponential model, (b) the Gaussian model, (c) the Spiral model, (d) the Exponential-Cosine model, (e) the Gaussian-Cosine model, and (f) the Harmonic model. The models are listed in order of increasing improvement when compared to the observational curve.

11:15 AM

HB.00005 - Influence of collapsing matter on the enveloping expanding universe, *ABDUL CHOUDHURY, Elizabeth City State University* — Using a collapsing matter model at the center of an expanding universe as described by Weinberg [1] we assume a special type of generated pressure [2]. This pressure transmits into the surrounding expanding universe. Under certain restriction the ensuing Hubble parameter is positive. The deacceleration parameter fluctuates with time, indicating that the universe accelerates for certain time and decelerates for other time intervals.

[1] S. Weinberg : Gravitation and Cosmology, J. Wiley & Sons, Inc. New York (1972) page 342.

[2] A. L. Choudhury, Hadronic J., 23, 581 (2000).

11:27 AM

HB.00006 - AdS/CFT Correspondence and Heavy Ion Collisions[1], *JAMES ALSUP, University of Tennessee, CHAD MIDDLETON, Rhodes College, GEORGE SIOPSIS, University of Tennessee* — We study perturbations of the gravity dual to a perfect fluid model recently found by Janik and Perschanski. We solve the Einstein equations in the bulk Anti-de Sitter space for a metric ansatz which includes off-diagonal terms. Through holographic renormalization, we show that these terms give rise to heat conduction in the corresponding gauge theory on the boundary. Our results might be relevant to understanding experimental results at heavy ion colliders such as RHIC.

[1]Supported in part by the DoE under grant DE-FG05-91ER40627.

11:39 AM

HB.00007 - E6 grand-unification for a Dark Energy model, *PAOLA MOSCONI, P.Q. HUNG, University of Virginia* — The unification of a recently proposed model for Dark Energy and Dark matter [1], based on an unbroken gauge group $SU(2)_Z$, with the Standard model (SM) is presented. The unifying group is E_6 and the symmetry breaking pattern takes the unusual route $E_6 \rightarrow SU(2)_Z \otimes SU(6) \rightarrow SU(2)_Z \otimes SU(3)_c \otimes SUP(3)_L \otimes U(1)_6 \rightarrow SU(2)_Z \otimes SU(3)_c \otimes SU(2)_L \otimes U(1)_3 \otimes U(1)_6 \rightarrow SU(2)_Z \otimes SM$. We find that the SM couplings converge into $SU(6)$ at a mass scale (2×10^{15}), corresponding to a proton mean lifetime $\tau_p \sim 9 \times 10^{32}$yr, consistent with the actual lower bound, while the E_6 grand-unification occurs below the Planck scale. This scenario implies the existence of heavy mirror fermions with masses (250).

[1] P. Q. Hung, hep-ph/0504060; ibid., Nucl. Phys. B **747**, 55 (2006).

11:51 AM

HB.00008 - A Classical Complex 4-Wave Foundation of the Cosmic-Quantum Mechanism, *MART GIBSON* — A model of a fundamental ½ spin quantum as a simple harmonic oscillation of an expanding 3-space of variable inertial density and resonant frequency in an underlying 4-continuum is developed. Expansion provides a mechanical analogue of an EMF which drives the neutral quantum. Absent inertial confinement, a differential decrease in inertial density creates a discontinuity, inducing a decrease in frequency to that of the proton, with transmission of the electron. Quantum gravity arises as the derivative of the wave force with respect to the expansion tension stress, and the Planck area as the derivative of the fundamental cross-sectional scale with respect to a change in stress. An exponential Hubble rate is coupled with the differential wave force and thereby beta decay. The nature of matter and anti-matter as inductive and capacitive states, respectively, is straightforward. A quantum mechanism, with animation, modeling the above is developed with the derivation of an inertial constant, $t(tav) = \hbar/c$. A matrix of the wave symmetries, functions, invariants, and their couplings is examined, clearly showing the relationship of the electromagnetic and gravitational interactions.

SESSION HC MATERIALS II

Williamsburg Hospitality House, Yorktown
Chair: Chris Hughes (James Madison University)
Friday, November 10, 2006 10:15 AM - 12:15 PM

10:15 AM

HC.00001 - Probing Chemicurrent Production in Ultra-thin Film Schottky Diode Devices using Hyperthermal Energy Ion Beams.[1] *MATTHEW RAY, CHAD SOSOLIK, Clemson University* — We are investigating the interactions of hyperthermal energy ions with ultrathin film Schottky diode devices, probing the role of ion-surface impact events and charge transfer on chemicurrent production. Chemicurrents are a fundamental "chemical current" that arises from electron hole pair production at a diode surface. To date, these currents have been explored only for thermal energy gas-surface impacts. Using a UHV beamline to produce well-collimated monoenergetic noble gas and alkali-metal beams from 10 eV to 10 keV, we have the unique flexibility to probe our in-house designed diode devices with a wide range of incident species, energies, and charge states. Preliminary results are presented and discussed in the context of basic gas-surface energy transfer processes.

[1]Work supported in part by NSF-CHE and NASA-REAP

10:27 AM

HC.00002 - The modification of nanocomposite hybrid polymer surfaces by exposure to oxygen containing plasmas, *ASHLEY FIGUEIREDO, Sweet Briar College, KATHERINE ZIMMERMANN, BRIAN AUGUSTINE, CHRIS HUGHES, James Madison University, CHARLES CHUSUEI, University of Missouri-Rolla* — The wetting properties of the surfaces of the nanocomposite hybrid polymer poly[(propylmethacryl-heptaisobutyl-polyhedral oligomeric silsequioxane)-co-(methylmethacrylate)] (POSS-PMMA) has been studied before and after exposure to plasmas containing oxygen. The contact angle of water droplets on the surface showed a substantial decrease after plasma exposure indicating an increase in the hydrophilicity of the surface. A model was developed in which the plasma preferentially removed organic material including both the PMMA backbone and isobutyl groups from the corners of the POSS cages leaving behind a surface characterized by the silicon oxide-like POSS material. Measurements of surface concentrations of oxygen, silicon, and carbon by x-ray photoelectron spectroscopy (XPS) showed an increase in the amount of oxygen and silicon compared to carbon and the appropriate chemical shifts were observed in the XPS data to support the model of Si-O enrichment on the surface. Variable angle spectroscopic ellipsometry (VASE) and atomic force microscopy (AFM) measurements also supported the model and these results will be presented.

10:39 AM

HC.00003 - Nuclear Magnetic Resonance Chemical Shift Calculation of Bulk Crystalline Materials[1], *DANIEL PECHKIS, ERIC WALTER, HENRY KRAKAUER, College of William and Mary* — Recent ^{17}O nuclear magnetic resonance (NMR) measurements for PZT solid solutions

have given a new understanding of the local structure within this material. Due to the low signal to noise ratio in the experimental spectrum, some ambiguities in these data remain. The experimental results may be clarified by first principles density functional theory (DFT) calculations of the NMR properties. NMR is an excellent tool for studying short range chemical order in crystalline solid state systems. The electric field gradient experienced by quadrupole nuclei indicate the local symmetry of a crystallographic site. While the isotropic chemical shifts felt by the nuclei indicate the number of distinct crystallographic sites. The shift tensor shows the orientation of the nuclei with respect to the externally applied magnetic field. The tensor also indicates the variations in shielding by the electronic environment in response to an applied magnetic field. Our recent DFT ^{17}O chemical shift results of PZT will be presented.

[1]Supported by ONR

10:51 AM

HC.00004 - Development and Testing of MEAM Potential for Al-Mg Alloys, *BOHUMIR JELINEK, SUNGHO KIM, JEFFERY HOUZE, SEONG-GON KIM, MARK HORSTEMEYER, Mississippi State University, MICHAEL BASKES, Los Alamos National Laboratory* — A MEAM potential for Al-Mg alloys was developed based on the elastic and structural properties determined from ab-initio calculations. Transferability of the new potential was tested by comparing various bulk, surface, and point defect properties with ab-initio simulations. Volume energy dependence of Al and Mg in fcc, hcp, bcc and simple cubic crystal structures from MEAM and ab-initio simulations was determined. Heat of formation for Al-Mg crystals with several different stoichiometries and structures was calculated using both methods. Surface formation, stacking faults, and adsorption energies were also compared. For point defects calculations, a close agreement of vacancy formation energies, interstitial and substitutional point defect energies was found.

11:03 AM

HC.00005 - Thigtness Compound Climatic Test - Q_C, *MARIANA CORNELIA BUTNARU, APS* — This method determinate the suitabilty of materials components, finished products and others to stressful conditions like: cold, heat, UV and IR radiations . . . others. Generally, the thigtness is testing in lab environmental conditions. But some materials, components or finished products are used transported or/ and deposited in special climatic conditions. So when we test thighness we must mimic the environmental factors of aging. The samples are same elastomers of general use (used for gaskets). The rubber was studied using IR measurements. We studied the structural changes which appear due to the climatic factors on samples of N50 rubber. The elastomer was cooled and irradiated with UV radiation. Due to cooling a new spectral band at 1443 cm^{-1} appears, and also the intensity of spectral band from 1432 cm^{-1} decreases. The most important structural changes, due to the degradation action of the ultraviolet radiations, appear after 10 hours of the action of the aging factor. The rubber was also studied with photoacoustic technique. An important decrease of thermal diffusity with the number of climatic cycles (aging factor - cold) and the UV irradiations dose was observed for N50 type samples. We assume that a variety of structural changes have been produced. This kind of elastomer is not a resistent one to stressful conditions. The results proved that thigtness compound method Q_C, works, is a very imortant one and must be applied.

11:15 AM

HC.00006 - Solitary Wave Behavior in Grains in One Dimension, *COREY KIM, NCSSM/ Duke University* — I observed the propagation of stress from one grain to the next when stacked in a vertical column. The grains that were used are made of a photoelastic material, which allows instantaneous visual evidence of the amount of stress at each point of each grain. An impulse was applied to the top of the granular system in the form of a plexiglas rod which was allowed to drop in free fall onto the grains. The process is recorded with a high speed camera, capturing about three to six frames where the stress is still in the process of traveling through the observed grains. Based on the pictures taken, it is possible to quantify the force at each grain, and to model the stress propagation as a wave. I explored the theory that the stress travels as a solitary wave, which is said to have a constant velocity that is proportional to the amplitude. In this case, amplitude was controlled by the initial height of the impulse-applying rod.

11:27 AM

HC.00007 - The Effect of Nanoscopic Bubbles on the Viscosity of Fluids at a Solid-Liquid Interface, *JONATHAN M. JONES, Appalachian State University* — It has been suggested that gaseous nanobubbles formed at solid-fluid interfaces may be responsible for a reduced interfacial viscosity at those surface boundaries. Here, we present measurements of the changing interfacial viscosity using both hydrophilic (Au, and SiO_2) and hydrophobic (octadecanethiol self assembled monolayers (SAMs) on Au) at the interface of a coated gold electrode submerged in seltzer water, sonicated DI water, and DI water distilled in a vacuum chamber. We monitor changes in the resonant frequency of our quartz oscillator, and from the frequency measurements we can determine the viscosity. By acquiring movies of bubble formation on the QCM surface in seltzer water and correlating these movies with the measurements of the QCM frequency, we see that the measured viscosity of the seltzer water is decreased due to the presence of bubbles on the gold electrode. As the seltzer water goes flat with increasing time, the measured viscosity increases, approaching the viscosity of water as expected. We suggest similar behavior occurs with nanobubbles, and present data for DI water which has been distilled to varying degrees. On the hydrophobic surfaces, the bubbles form more readily, which results in a reduced interfacial viscosity as compared to the hydrophilic surfaces.

11:39 AM

HC.00008 - Shear Strength and Microstructure of Sn-3Ag-0.5Cu Solder Joints[1] **,** *SYLVESTER EKPE-NUMA, Claflin University, MIN HE, VIOLA ACOFF, The University of Alabama* — Sn-Ag-Cu based solders have been studied extensively as they show great promise for use in electronics assembly and packaging industry as alternatives to Sn-Pb based solders. As a further test of the reliability of these solders, the shear strength of single lap shear Sn-Ag-Cu solder joints was investigated. The microstructures of the solder joints and the fracture surfaces were examined using SEM.

[1]Work supported by NSF grant DMR-0349851

11:51 AM

HC.00009 - A novel method for the fabrication of microfluidic devices by photopolymerization of polymethylmethacrylate, *JACOB FORSTATER, BRIAN AUGUSTINE, CHRIS HUGHES, James Madison University* — We have developed a new technique for the rapid fabrication of structures useful for microfluidic devices called micromolding by photopolymerization in capillaries (μ-PIC). The technique involves the replication of features from a silicon master in which features on the order of tens to hundreds of microns have been formed by crystallographic etching. The negative of the features is then transferred to a sheet of polymethylmethacrylate (PMMA) by placing the PMMA sheet over the silicon master and injecting a solution of methylmethacrylate monomer with a benzoin methyl ether photoinitiator. This solution is drawn between the PMMA and the silicon by capillary action forming a liquid layer that is no more than a few hundred microns thick. This liquid is then polymerized by exposure to ultraviolet light for less than a half hour. The features transferred in this manner have nearly identical surface structure and roughness. Analysis of these surfaces and structures by atomic force microscopy and scanning electron microscopy will be presented.

12:03 PM

HC.00010 - Osmotic Pressure: Conceptions & Misconceptions from Pfeffer, to Van't Hoff, to Einstein, to Fermi, to the Present, *THEODORE R. REIFF* — A phenomenological approach to understanding osmotic pressure in terms of competing effects of solute solvent, solute-solute, and solvent-solvent interactions helps to avoid the misconceptions about osmotic pressure that were held by Van't Hoff, Einstein, Fermi, and many others. It also provides a better understanding of the concept of "negative" osmotic pressure and its role in explaining water of crystallization, gel syneresis, and in biological tissue aging and pathological states. Negative osmotic pressure may be conceptualized as due to a transient metastable state wherein the chemical potential of solvent is temporally increased above that of pure solvent in the standard state. Measureable changes in differential osmotic pressure volume relationships of osmotic systems are readily related to differential changes in solvent chemical potential and number of mols of solvent in a system.

SESSION JA TOUR OF JEFFERSON LAB

Friday, November 10, 2006 1:00 PM - 5:00 PM

1:00 PM

Tour of Jefferson Laboratory — The Department of Energy's Thomas Jefferson National Accelerator Facility was constructed between 1987 and 1992. Operation of its Continuous Electron Beam Accelerator Facility, based on superconducting radio-frequency accelerating technology, began in 1994. This it is the world's most advanced particle accelerator for investigating the quark structure of the atomic nucleus. Today JLab employs over 500 staff members and serves a nuclear physics user community of over 2000 international scientists, including many faculty and students from the SESAPS region. With industry, defense and university partners, Jefferson Lab has a derivative mission as well: applied research for using the Free-Electron Lasers based on technology the laboratory developed to conduct its physics experiments. Buses will leave the Williamsburg Hospitality house beginning at 1 PM for the 17-mile trip to Jefferson Lab. Once there, visitors will circulate among six sites, where they can see the CEBAF accelerator and its operations center, experimental halls where beams interact with targets to explore details of the sub-nuclear force, and a kilowatt-class high average-power, sub-picosecond free-electron laser, covering the mid-infrared and ultra-violet spectral region. Buses will be available to return visitors to the Williamsburg Hospitality House until 5 PM. You must be 18 years old or over to attend the tour. There will be a lot of walking. Safety requirements dictate pants and close-toed shoes with no sandals or high heels. Note that the accelerator portion of the tour is NOT handicapped accessible and you must be able to walk up and down four flights of stairs. *Important Notice for JLab visitors who were born outside the United States.* U.S. Department of Energy headquarters approval is required before any persons whose country of birth is Cuba, Iran, North Korea, Sudan or Syria can enter DOE facilities, including Jefferson Lab. Visitors from these countries may not be on site or tour Jefferson Lab without first going through this formal approval process. This process may take up to six (6) months. Please contact Linda Ware at ware@jlab.org if you have questions or need to apply to the DOE for the tour.

SESSION KA SESAPS BUSINESS MEETING

Williamsburg Hospitality House, Jamestown
Chair: Paul Avery (University of Florida)
Friday, November 10, 2006 5:30 PM - 6:15 PM

SESSION LA SESAPS BANQUET

Williamsburg Hospitality House, Empire A/B/C
Friday, November 10, 2006 6:30 PM - 10:00 PM

7:00 PM

LA.00002 - A Virtual National Laboratory for Predicting Hurricane Impacts, *PHILIP BOGDEN, SURA/SCOOP Program Director and CEO, GoMOOS* — The 2005 Atlantic hurricane season was the most active in recorded history. Collectively, the 2005 hurricanes caused more than 2,280 deaths and record damages of over 100 billion dollars. Of the storms that made landfall, Dennis, Emily, Katrina, Rita, and Wilma caused most of the destruction. Accurate predictions of water level, wave height, and inundation can save lives and reduce recovery costs, provided the information gets to emergency responders in a timely manner. The information must be received well in advance of a storm making landfall, so that responders can weigh the costs of unnecessary evacuation (estimated at over 1 million dollars per mile of coastline) against the costs of inadequate preparation. Tracking large storms is already challenging; predicting the impacts days before the storm makes landfall imposes enormous new challenges. This requires an entirely different approach than is usually involved in producing the single best forecast for a specific event. Hazard planning requires an estimate of the uncertainty in the forecast. Calculating such probabilities requires that computer simulations be run not once, but many hundreds or thousands of times—once for each plausible outcome—creating huge computational demands. Add the requirement for real-time observations needed to increase predictive capability and the complexity of the information flow grows to include a wide variety of ocean-based sensor platforms. From ocean-bound sensors to supercomputers to the decision-maker's desk, the predictions must be turned around in a matter of hours if they are to affect decision-making. Scientists from universities across the Southeast are creating a cyberinfrastructure—a virtual and distributed laboratory – that combines the knowledge, data-integration capacity, and computational power necessary for real-time environmental prediction and hazard planning. This vision supports a national, multi-agency initiative called the Integrated Ocean Observing System. For more information on this remarkable partnership, visit http://scoop.sura.org/.

SESSION MA RISING ABOVE THE GATHERING STORM

Invited Session

Williamsburg Hospitality House, Empire A/B — Chair: David G. Haase (North Carolina State University)

Saturday, November 11, 2006 8:30 AM - 10:30 AM

8:30 AM

MA.00001 - Revitalizing Support for the Physical Sciences: The American Competitiveness Initiative, *PETER ROONEY, U.S. House of Representatives* — In January 2006, during his *State of the Union Address*, President Bush announced a renewed commitment on the part of his Administration to funding math and science education, and science and engineering research. Two weeks later, in February 2006, the President submitted his budget request to Congress, including *The American Competitiveness Initiative* (ACI), a budget initiative that proposes to double federal investments in fundamental research in the physical sciences at three civilian science agencies—the Office of Science in the Department of Energy, the National Science Foundation (NSF), and the National Institute of Standards and Technology (NIST)—over ten years. To date, ACI has fared well in Congress. The House of Representatives has already approved the increases for the Office of Science (up 14 percent), NSF (up 8 percent), and NIST (core laboratory research and infrastructure up 24 percent). Key Senate Subcommittees have approved similar increases. Of equal significance to the budget proposal, the President's pronouncements represent an effort to change the public perception of the value of science. This is the capstone of a fifteen-year effort on the part of the scientific community, including the American Physical Society, to develop a new rationale for funding physical science research in the post-Cold War era. 30 years of economic research suggests there is a strong correlation between the government investments in education and research, particularly physical science and engineering research, and future economic performance. The President made this connection explicit for the public in his *State of the Union Address* and in subsequent speeches and town hall meetings. The author will discuss these trends and the outlook for ACI going forward.

9:00 AM

MA.00002 - The Changing Landscape of Undergraduate Physics, *RUTH HOWES, Marquette University* — The National Task Force on Undergraduate Physics was convened by APS, AAPT and AIP to study the steep decline in the number of physics majors that occurred during the 1990s. The Task Force conducted project SPIN-UP (Strategic Programs for Innovations in Undergraduate Physics) to investigate why some departments were thriving while others are losing majors. With support from the ExxonMobil Foundation, we conducted site visits to 21 "thriving" departments and have worked with the AIP statistics program to survey the 562 departments that grant undergraduate degrees in physics. The results of the study identified key ingredients in thriving departments and essential elements needed to make changes that respond to the changing environments in which physics departments find themselves. Today, enrollments in undergraduate physics are climbing again. We need to ensure that this positive trend continues and ensure that we attract women and members of underrepresented groups to the study of physics.

9:30 AM

MA.00003 - Physics Majors: Where do they come from? Where do they go? *PATRICK MULVEY, Statistical Research Center, American Institute of Physics* — Physics majors represent a small but important part of the physics education system in the United States. They also make up an equally small but important part of the workforce and supply post secondary institutions with students pursuing graduate level degrees in physics. This paper will give an over view of the backgrounds of undergraduate physics majors, the types of institutions and departments they attend, and their experiences as undergraduates. It will outline the types of employment new physics bachelors accept including employment sectors, work activities and the fields in which they are employed. Finally, it will give an overview of the physics majors (and others) who pursue graduate level physics education and their initial employment outcomes.

10:00 AM

MA.00004 - Seeds and Sparks: Cultivating Children's Interest in Physics through Public Outreach, *JESSICA CLARK, American Physical Society* — The National Academies' "Rising above the Gathering Storm"[1] report names the improvement of K-12 science and mathematics education as its highest priority recommendation. This recommendation includes enlarging the pipeline of students preparing to study STEM[2] subjects at university by increasing the number of students who take (and pass) advanced high school level science courses. To this end, the American Physical Society's Public Outreach department offers PhysicsQuest, a free program designed to engage middle school science students in a learning adventure. The core idea of the program is to provide a fun and exciting way for students to encounter physics, thereby eliminating some of the fear often associated with the subject and making them more likely to take high school physics courses. In the end, the students do learn some physics, but, more importantly, they have a fun experience with physics. This talk further describes the PhysicsQuest program, including feedback and results from the 2005 project, and also gives an overview of other K-12 programs offered by APS Public Outreach.

[1]The report can be read online at http://www.nap.edu/catalog/11463.html#toc.

[2]Science, Technology, Engineering, Mathematics

SESSION MB NUCLEAR PHYSICS III
Williamsburg Hospitality House, Huntington
Chair: David Armstrong (College of William & Mary)
Saturday, November 11, 2006 8:30 AM - 10:18 AM

8:30 AM
MB.00001 - Parity Violating electron scattering from Hydrogen and Helium-4 and Strangness in the nucleon: Results from HAPPEX-II, *BRYAN MOFFIT, College of William and Mary, HAPPEX COLLABORATION, HALL A COLLABORATION* — The quark-antiquark pairs that form the sea within the nucleon are well established within quantum chromodynamics. Several recent and ongoing experiments are motivated by determining how this sea, containing contributions from all quark flavors, plays a role in affecting the nucleon's overall properties. Of particular interest is the possible strange quark contribution to the nucleon's electric and magnetic form factors. The recently completed HAPPEX asymmetry measurements take advantage of parity violation in elastic electron scattering to probe the strange quark effects. The measurement using a hydrogen target is sensitive to a linear combination of G_E^S and G_M^S, the contribution to the electric and magnetic form factors due to strange quarks, respectively, whereas scattering from a spinless helium target cleanly isolates G_E^S. The combination of the two measurements therefore allows these form factors to be separately determined. Final results will be presented from the complete data set, obtained in runs in 2004 and 2005, yielding results of unprecedented precision.

8:54 AM
MB.00002 - Extracting nucleon strange and anapole form factors from world data, *ROGER CARLINI, ROSS YOUNG, ANTHONY THOMAS, Jefferson Lab., Newport News, Va., JULIE ROCHE, Ohio University, Athens, Ohio* — The complete world set of parity violating electron scattering data up to $Q^2 \sim 0.3$ GeV^2 is analyzed. We extract the current experimental determination of the strange electric and magnetic form factors of the proton, as well as the weak axial form factors of the proton and neutron, at $Q^2 = 0.1$ GeV^2. Within experimental uncertainties, we find the strange form factors are consistent with zero, as are the anapole contributions to the axial form factors. Nevertheless, the correlations between the strange and anapole contributions suggest that there is only a small probability that these form factors all vanish simultaneously.

9:06 AM
MB.00003 - Rescattering of the $\sum^-(1385)$ and the K^+ on the proton, R.M. Davis (GWU), for the CLAS Collaboration, *REBECCA DAVIS, George Washington University, CLAS COLLABORATION* — Due to the short lifetime of excited hyperons, studies on their scattering are lacking. Since neither beams nor targets can be created, the only possibility is to use final-state interactions. We studied the reaction $\gamma\, n \rightarrow K^+ \sum^-(1385)$, detecting the K^+, π^-, π^-, p in the final state. These data were obtained in the g10 experiment at Jefferson Lab, which used real photons and a deuterium target in the CLAS. The $\sum^-(1385)$ and the intermediate Λ were identified from their invariant masses. The additional 'spectator' proton was either detected or identified by missing mass. Once all particles were identified, we were able to look for high-t events with spectator proton momenta above 0.4 GeV/c. Though the statistics are limited, we plan to determine the quasifree and the rescattering cross sections.

9:18 AM
MB.00004 - Λ Hypernuclear Spectroscopy up to the Medium-Heavy Region Through the ($e,e'K^+$) Reaction, *LEON COLE, Hampton University, HKS COLLABORATION, COSM TEAM* — The "Spectroscopic Study of Λ Hypernuclei up to the Medium-Heavy Mass Region Through the ($e,e'K^+$) Reaction" (HKS Experiment) was successfully completed during the summer of 2005 at Jefferson Laboratory. It utilized a new High Resolution Kaon Spectrometer (HKS) and a "Tilt Method" on the electron arm. These features aim to achieve the best ever hypernuclear energy resolution and the highest possible production yield of Λ Hypernuclei. The goal of the experiment is to investigate Λ hypernuclear structures with precise measurements of the mass spectra from light to medium-heavy mass region. Such precise spectroscopy will provide valuable information on the single-particle behavior of Λ hyperon in a nuclear medium and gain knowledge on the effective Λ-N interaction and nuclear structure probed by the Λ hyperon. An overview of HKS experiment will be presented and preliminary results of the excitation spectra from various targets will be showcased.

9:30 AM
MB.00005 - High Resolution 1P-Shell Hypernuclear Spectroscopy at JLAB, HALL A (E94-107), *ARMANDO ACHA, PETE MARKOWITZ, Florida International University, HALL A COLLABORATION* — Information about the force between nucleons and strange baryons, i.e. the Λ-N interaction, can be obtained by studying the spectroscopy of nuclei where a nucleon is replaced by a Lambda hyperon to form a bound state. Hypernuclear spectroscopy via electromagnetic induced reaction has been measured in Hall A at Jefferson Lab on 1p-shell nuclei, C^{12}, Be^9 and O^{16} . The reaction constitutes an innovative experimental approach to study hypernuclei, providing an alternative to the hadronic induced reactions studied so far. Jefferson Lab's electron beam features and the available experimental equipment in Hall A offered a unique opportunity to perform this experiment. Among the features needed are a narrow beam energy spread ($\sigma E/E\ 10E^{-5}$), high resolution spectrometers (missing energy resolution less than 500 KeV FWHM) and good particle identification. Modifications were made to the Hall A standard apparatus: two superconducting septum magnets were added to the spectrometer systems to allow particle detection at very forward angles. The particle identification for the experiment required separating kaons from large pion and proton backgrounds, and electrons from pion backgrounds.

Preliminary results with a missing energy resolution of 750 KeV FWHM show good correlation with available theoretical models. Details about results will be shown.

9:42 AM

MB.00006 - Combined analysis of $\pi^+ \to e+\nu\gamma$ decay in the PIBETA data stream. *MAXIM BYCHKOV, University of Virginia, PIBETA COLLABORATION* — The PIBETA experiment, carried out at the Paul Scherrer Institute, Switzerland, has acquired the world's largest data set of radiative pion decay events $\pi^+ \to e+\nu\gamma$ to date. Radiative pion decay is the premier source of information regarding the charged pion structure, and it provides an independent check of the CVC hypothesis of the weak interactions. The data were collected in two separate runs. Analyses of the original data sample indicated possible discrepancies with the Standard Model of elementary particles, and prompted a dedicated run specifically optimized for the radiative pion decay study. In this talk we present the analysis of the dedicated run as well as a fresh look at the old data with an improved understanding of the systematic effects and with increased statistics.

9:54 AM

MB.00007 - Redesign of the PIBETA Beam Detectors for a New π_{2e} Experiment at PSI, *EMIL FRLEZ, University of Virginia, PEN COLLABORATION* — PEN, a new experiment aiming to measure the $\pi+ \to e+\nu$ (π_{2e}) decay branching ratio with a relative uncertainty of $\sim 5 \cdot 10^{-4}$ has begun this year at the Paul Scherrer Institute ring accelerator. A development run with an upgraded PIBETA detector was conducted during the summer of 2006. In this contribution we discuss the design and performance of the new beam detectors: the upstream beam counter, and the active collimator, degrader and target using low-momentum 72-80 MeV/c $\pi+$ beams. All beam detector waveforms were digitized with a 2 GHz/10 bit Acqiris digitizer.

10:06 AM

MB.00008 - Search for Sub-Threshold J/psi Photoproduction[1], PARIKSHIT JUNNARKAR[2], Mississippi State University — We present results from the recent Jefferson Lab experiment E03-008: "Subthreshold J/ψ Photoproduction." A beam of 6 GeV electrons was impinged on a thick carbon target and lepton pairs were detected in two magnetic spectrometers in Hall C. The kinematics were sub-threshold to production from a free proton, so the experiment probed the short distance configuration in the nucleus, where one expects sensitivity to higher twist effects (such as three-gluon exchange), intrinsic charm contributions, and possible multi-quark resonances involving charmed quarks. An upper bound for the cross section near threshold will be presented.

[1]This research was supported in part by U.S. Department of Energy under grant number DE-FG0204ER41330

[2]Representing the E03-008 Collaboration

SESSION MC HIGH ENERGY PHYSICS II

Williamsburg Hospitality House, Empire C
Chair: Simonetta Liuti (University of Virigina)
Saturday, November 11, 2006 8:30 AM - 10:18 AM

8:30 AM

MC.00001 - Status of the ATLAS Transitional Radiation Tracker, *RICHARD WALL, Duke University, ATLAS COLLABORATION* — The ATLAS Transition Radiation Tracker (TRT) is a straw tube tracking system, which, together with the silicon tracking system, will provide precision measurements of particle tracks that are crucial for the discovery potential of the ATLAS detector at the Large Hadron Collider (LHC). Here we will overview the status of the TRT integration and commissioning, and discuss results on its alignment and tracking efficiency using recent cosmic-ray data. This understanding is important for optimizing the tracking and particle identification capabilities of the TRT for when physics results are expected in late 2007.

8:42 AM

MC.00002 - Calibration, Installation & Commissioning of Sensors for the Alignment of Muon Endcap Chambers in the CMS Experiment, *SAMIR GURAGAIN, MARCUS HOHLMANN, Dept. of Physics, Florida Institute of Technology, Melbourne, Florida 32901, US CMS COLLABORATION* — The positions of muon endcap chambers are to be monitored precisely in the Compact Muon Solenoid (CMS) experiment at the Large Hadron Collider (LHC) by using analog sensors (R sensors, Z sensors, proximity sensors, and inclinometers) and optical DCOP sensors based on CCDs. The analog sensors were calibrated at Florida Tech using a semi-automated mechanical calibration bench and a Labview-based control and readout system. In summer 2006, half of all the sensors and readout were installed and commissioned on four endcap layers. Laser beams were carefully adjusted for passage through all DCOPS on 15m Straight Line Monitors (SLM) across three endcap disks. During the summer, the detector was closed up and the huge 4 Tesla solenoid magnet of CMS was turned on for the first time ever. The movement of muon chambers for the alignment in R-Ø and Z directions was monitored continuously by a complex system of wire extension and linear motion potentiometers, inclinometers, and DCOPS during the CMS Magnet Test & Cosmic Challenge in the summer. Sensors clearly indicated the flexing of the large absorber disks when the field was turned on. We present sensor calibration methods and results, an overview of the installed sensor system, and first commissioning results for the endcap alignment at CERN. Supported by Florida Tech, Fermilab and Department of Energy.

8:54 AM

MC.00003 - Muon Ionization Cooling for an 8 TeV Lepton Collider[1], *DON SUMMERS, University of Mississippi* — A scenario for cooling muon bunches a factor of a million will be presented. Such cold muon bunches are the key to building an 8 TeV $\mu^+\mu^-$ lepton collider to explore the energy

frontier. Ionization in hydrogen slows muons in all directions. RF cavities add momentum back in just one direction. Steps involved include a straight ionization/RF channel for initial transverse cooling, a *Guggenheim* spiral for 6D cooling, a slip stacking ring for bunch coalesance, two 6D ionization cooling rings, and a final straight transverse cooling channel employing 50 Tesla BSCCO superconducting solenoids filled with liquid hydrogen. A two megawatt proton source ($p \rightarrow \pi \rightarrow \mu$) appears to be adequate to provide high luminosity for a $\mu^+\mu^-$ collider. A program to learn how to build 50 Tesla solenoids has commenced at Fermilab. Other labs and universities are collaborating. Currently, 25 Tesla solenoids have been built. The current carrying capacity of BSCCO has been measured to be 266 Amps/mm^2 at 45 Tesla and 4^0 K in Florida.

[1]Work supported by DOE grant DE-FG05-91ER40622.

9:06 AM

MC.00004 - The MiniBooNE event reconstruction and particle identification, DENIS PEREVALOV, University of Alabama — The MiniBooNE event reconstruction and particle identification are described. The related light model, input parameters and likelihood methods used in the event reconstruction, as well as the boosted decision trees algorithms advocated in the particle identification are explained.

9:18 AM

MC.00005 - Three flavor neutrino oscillation analysis of atmospheric neutrinos in Super-Kamiokande, *ROGER WENDELL, Duke University, SUPER-KAMIOKANDE COLLABORATION* — The nature of the neutrino mass hierarchy and the possibility of a nonzero θ_{13} are open problems in neutrino physics that can be probed by extending the standard two-flavor neutrino oscillation scenario to include all active flavors. In a three-flavor oscillation scheme there is known resonant enhancement (suppression) of the $\nu_\mu \rightarrow \nu_e$ transition probability in matter for several GeV neutrinos at long baselines for a normal (inverted) hierarchy when $\theta_{13} > 0$. This effect is not present for the corresponding anti-neutrino transition. The Super-Kamiokande I atmospheric data have been analyzed using a three-flavor model testing both the normal and inverted mass hierarchies and no significant change in flux was found in its enriched multi-GeV ν_μ or ν_e samples. Accordingly, confidence intervals for the atmospheric oscillation parameters have been obtained, the best fits being consistent with previous atmospheric results and zero θ_{13} for both hierarchies.

9:30 AM

MC.00006 - Parameterization of Parton Distributions Functions Based on Self-Organizing Maps, *Y. LOITIERE, H. HONKANEN, S. LIUTI, University of Virginia* — Neural network algorithms have been recently applied to construct Parton Distribution Function (PDF) parametrizations which provide an alternative to standard global fitting procedures [1]. In this contribution we propose a diffrerent technique, namely an interactive neural network algorithm using Self-Organizing Maps (SOMs) [2]. SOMs generate a nonuniform projection from a high dimensional data space onto a low dimensional one (usually 1 or 2 dimensions) by clustering similar PDF representations together. Our SOMs are trained on progressively narrower selections of data samples. The selection criterion is that of convergence towards a neighborhood of the experimental data. Our procedure utilizes all available data on deep inelastic scattering in the kinematical region of $0.001 \leq x \leq 0.75$, and $1 \leq Q^2 \leq 100$ GeV^2, with a cut on the final state invariant mass, $W^2 \geq 10$ GeV^2. Our main goal is to provide a fitting procedure that, at variance with standard neural network approaches, allows for an increased control of the systematic bias. SOMs, in fact, enable the user to directly control the data selection procedure at various stages of the process.

[1] L. Del Debbio, S. Forte, J. I. Latorre, A. Piccione and J. Rojo, [NNPDF Collaboration], JHEP **0503**, 080 (2005).

[2] T. Kohonen, "Self Organizing Maps," Springer-Verlag, 1997.

9:42 AM

MC.00007 - Studying the Phase-Space Structure of Nucleons Using Generalized Parton Distributions, *SAEED AHMAD, SIMONETTA LIUTI, HELI HONKANEN, SWADHIN K. TANEJA, University of Virginia* — We study the correlation of momentum and coordinate space distributions of partons which are measured in Deeply Virtual Compton Scattering (DVCS) reactions. Being able to understand the phase-space distributions of quarks, we hope to look into the question of 'how much quark orbital angular momentum contributes towards the nucleon spin?' It was in fact suggested recently [1] that using the information provided by DVCS experiments, one can develop a complete three dimensional spatial picture of nucleons, along with the momentum distributions (the so-called Wigner distributions). However, in order to pin down the spatial distribution in the longitudinal direction one has to take into account the constraint imposed by the uncertainty principle. In addition, similarly to inclusive deep-inelastic scattering, the lectromagnetic probe has an extended length in the longitudinal direction, known in the literature as "Ioffe time" [2]. Using the Generalized Parton Distributions (GPDs) obtained in [3] we define and evaluate "Generalized Ioffe time" distributions as a function of the additional degrees of freedom-both transverse, $t = -\Delta^2$ and longitudinal, ξ–extracted from DVCS experiments.

[1] A. V. Belitsky, X. d. Ji and F. Yuan, Phys. Rev. D **69**, 074014 (2004) [2] B. L. Ioffe, Phys. Lett. B **30**, 123 (1969); V. Del Duca, S. J. Brodsky and P. Hoyer, Phys. Rev. D **46**, 931 (1992); V. Braun, P. Gornicki and L. Mankiewicz, Phys. Rev. D **51**, 6036 (1995). [3] S. Liuti and S. K. Taneja, Phys. Rev. D **70**, 074019 (2004); H. Honkanen, S. K. Taneja, S. Ahmad and S. Liuti, *in preparation*.

9:54 AM

MC.00008 - New Parametrization for Generalized Par-ton Distributions with Non-Zero Skewedness, *HELI HONKANEN, SWADHIN K. TANEJA, SAEED AHMAD, SIMONETTA LIUTI, University of Virginia* — We present a physically motivated parameterization for the unpolarized generalized parton distributions of the nucleon, $H(X, \zeta, t)$ and $E(X, \zeta, t)$, obtained from Deeply Virtual Compton Scattering (DVCS) experiments, where X is the struck parton's momentum fraction, ζ, skewedness parameter, is the fraction of longitudinal momentum transfer between the incoming (virtual) photon and the outgoing photon, and t is the four-momentum transfer squared. At variance with other physically constrained parametrizations available in the literature [1,2], ours is the first one that applies to both zero and non-zero values of the skewedness parameter, ζ. We define H and E using overlap integrals of the nucleon light-cone wave functions at large values of X [3], and assuming Regge behavior at low X. At $\zeta = 0$ we use the constraints provided by simultaneous fits to experimental data on both the elastic nucleon form factors and the "forward" parton distributions from deep inelastic scattering. Our results at $\zeta = 0$ are of the same quality of the ones obtained in [1,2]. In order to extend our parametrization to $\zeta \neq 0$, we work out additional constraints from recent lattice calculations of higher moments of generalized parton distributions [4].

[1] M. Diehl, T. Feldmann, R. Jakob and P. Kroll, Eur. Phys. J. C **39**, 1 (2005) [2] M. Guidal, M. V. Polyakov, A. V. Radyushkin and M. Vanderhaeghen, Phys. Rev. D **72**, 054013 (2005) [3] S. J. Brodsky, M. Diehl and D. S. Hwang, Nucl. Phys. B **596**, 99 (2001) [4] G. Schierholz and J. Zanotti, *private communication*.

10:06 AM

MC.00009 - Leptonic Structure Functions of Photons, *KLAUS DEHMELT, LASZLO BAKSAY, MARCUS HOHLMANN, Florida Institute of Technology, L3 COLLABORATION* — Virtual photons can fluctuate into diverse final states. This can be described in terms of structure functions for photons. Among other processes, such fluctuations can yield muon-pairs. Apart from supplying another test of QED, purely leptonic processes provide a calibration for the hadronic processes. We report on a measurement with single-tagged two photon events from the LEP experiment L3, at c.m.s. energies between 189 GeV and 206 GeV. An overview of the fundamental physical processes and a discussion of the structure function results will be presented.

SESSION NA ASTRONOMY AND ASTROPHYSICS

Invited Session

Williamsburg Hospitality House, Empire A/B — Chair: Jonathan Keohane (Hampton-Sidney College)

Saturday, November 11, 2006 10:45 AM - 12:45 PM

10:45 AM

NA.00001 - The Extrasolar Planet Zoo, *ARSEN R. HAJIAN, US Naval Observatory* — In this talk, I will review the current state of extrasolar planets. Because this field of so large and time is limited, I will focus on the demographics of the current members, methods of detection, and what kinds of missions and investigations are being planned for the near future.

11:15 AM

NA.00002 - From EGRET to GLAST: The Past and Future of Gamma-Ray Blazars[1], *STEVEN BLOOM, Hampden-Sydney College* — I will begin by discussing the blazar phenomenon and putting this in context of the most recent high energy gamma-ray observations of blazars, particularly those of the Energetic Gamma-Ray Telescope Experiment (EGRET). These results will include my own most recent statistical analysis and simulations. Finally, I will discuss implications for observations with the Gamma-Ray Large Area Telescope (GLAST), due for launch in 2007.

[1]Visiting Scientist, National Radio Astronomy Observatory, Charlottesville, VA

11:45 AM

NA.00003 - The Early Successes of PROMPT: Rapid Observations of the Optical Afterglows of GRBs, *MELISSA NYSEWANDER, University of North Carolina at Chapel Hill* — Although construction began on PROMPT (Panchromatic Robotic Optical Monitoring and Polarimetry Telescopes) in only December of 2004, it has already produced exciting new data detailing both the temporal and spectral properties of GRB afterglows at early times. Since the beginning of full queue-based observing mode in mid-2005, PROMPT has responded seven times to real-time GRB triggers, producing multicolor lightcurves of the afterglows of four of these beginning only tens of seconds after the burst. PROMPT consists of six robotic 16” telescopes, located at CTIO, which were designed to capture the early optical afterglows of GRBs. Each telescope is optimized for a different pass-band, ranging from the UV through the optical and into the near-infrared. A sixth telescope will consist of an optical polarimeter, whose lightcurves will complement the remaining five telescopes and put important constraints on the physics of the early afterglow. Both the NIR camera and polarimeter are currently being commissioned at UNC and will be installed in late Fall of 2006.

12:15 PM

NA.00004 - Using Ultrahigh Energy Cosmic Rays to Probe New Physics, *SEAN SCULLY, James Madison University* — Due to the uncertainty principle, higher and higher particle energies are required to probe smaller and smaller physical scales. In the near future, earth-based particle accelerators may be able to achieve the TeV scale but to go beyond this, one must use the cosmic accelerators that nature has provided such as ultrahigh energy cosmic rays. The flux of these particles is expected to be dramatically attenuated by photomeson producing interactions with the cosmic microwave background as first pointed out by Greisen, Zatsepin and Kuzmin in the 1960s (the GZK effect). Yet some particles have been observed at energies above the GZK cutoff, and in particular by the Akeno array, which is in possible contradiction to the attenuation effect. We may indeed be seeing new physics beyond the standard model such as quantum gravity, extra dimensions, or string theory coming into play. For some of these effects, the modified particle energy spectrum can be calculated which leads to a lessening of the GZK effect. Such theoretical studies combined with new experimental data that will soon be available from the Auger array may lead to a revolution in our understanding of fundamental physics.

SESSION NC PHYSICS TEACHING
Williamsburg Hospitality House, Empire C
Chair: Kathy Whatley (University of North Carolina, Asheville)
Saturday, November 11, 2006 10:45 AM - 12:45 PM

10:45 AM
NC.00001 - Physics and Music I: Subharmonics on a violin String, *PHILLIP J. STILES, NC State University* — Of considerable interest to Physicists was the demonstration in the 1990's of subharmonic resonances on the G string of a violin. How can one explain these anomalous low frequencies. They are of the same quality as the normal resonances used to produce music on the violin. What is the interaction of human and the vibrating body? A survey of the understanding will be given.

11:09 AM
NC.00002 - Classical Mechanics with Computational Physics in the Undergraduate Curriculum, *J.E. HASBUN, University of West Georgia* — Efforts to incorporate computational physics in the undergraduate curriculum have made use of Matlab, IDL, Maple, Mathematica, Fortran, and C[1] as well as Java.[2] The benefits of similar undertakings in our undergraduate curriculum are that students learn ways to go beyond what they learn in the classroom and use computational techniques to explore more realistic physics applications. Students become better prepared to perform research that will be useful throughout their scientific careers.[3] Undergraduate physics in general can benefit by building on such efforts. Recently, I have developed a draft of a textbook for the junior level mechanics physics course with computer applications.[4] The text uses the traditional analytical approach, yet it incorporates computational physics to build on it. The text does not intend to teach students how to program; instead, it makes use of students' abilities to use programming to go beyond the analytical approach and complement their understanding. An in-house computational environment, however, is strongly encouraged. Selected examples of representative lecture problems will be discussed.

[1] "Computation and Problem Solving in Undergraduate Physics," David M. Cook, Lawrence University (2003).

[2] "Simulations in Physics: Applications to Physical Systems," H. Gould, J. Tobochnik, and W Christian.

[3] R. Landau, APS Bull. Vol 50, 1069 (2005)

[4] J. E. Hasbun, APS Bull. Vol. 51, 452 (2006)

11:21 AM
NC.00003 - Top-Down Physics, *MICHAEL SCHILLACI, University of South Carolina* — Over the past 7 years I have worked to develop two, two- semester course sequences in Theoretical and Computational Physics. Covering material traditionally handled in Classical Mechanics and Electricity and Magnetism, the Theoretical Physics sequence stresses mathematical rigor, physical insight and a project-based paradigm, covering topics such as Landing on the Moon, Realistic Tidal Models, and The Solar Sail. A two-volume text (recently adopted by Mercer University) has been developed for the Computational Physics sequence and introduces students to the essentials of Maple, LaTeX and JAVA as well as web-page (HTML, JavaScript) publishing. While the bulk of the first semester is devoted to software use and algorithm development (i.e., numerical integration) wrote homework is supplemented by "group quiz and project activities. In the second semester laboratory experiments such as the Toothpick Toss, The Not-So-Simple Harmonic Oscillator and the Chaotic Diode are performed and then computational simulations are developed using various tools (i.e., JAVA, Visual Basic, Matlab).

11:33 AM
NC.00004 - Distance Learning Courses and Master of Arts in Physics Education, *RICHARD LINDGREN, STEPHEN THORNTON, University of Virginia* — More than twenty distance learning courses in physics have been taken by hundreds of High School Physics Teachers over the past 7 years. The success of these courses helped initiate our 30 credit Master of Arts in Physics Education degree program. We have graduated 28 teachers over the last 6 years and expect 13 more to graduate in 2006. The candidates earn 14 credits in residence at the University of Virginia and 16 credits online. This allows teachers to matriculate, while earning more than half the credits at home. Presently, there are over 50 Master degree candidates. Three of the five online courses utilize CD-ROMS with edited lectures of live Physics courses taught at the University of Virginia by Physics Professors recognized for their teaching. Homework and examinations are submitted using WebAssign. Local high school teachers and administrators proctor the examinations. General communication and pedagogical feedback on homework assignments and exams are submitted through Blackboard as well as email. Screen captured video shots of physics demonstrations are widely used in the audio chat room to facilitate discussion and also used on examinations. We will discuss the changes of our distance-learning model based on what has worked (or not) and new technology.

11:45 AM
NC.00005 - Conferences on K-12 Outreach from University Science Departments[1], *DAVID G. HAASE, SHARON K. SCHULZE, Physics Department and The Science House, NC State University* — Recent reports such as Rising Above the Gathering Storm have energized the science community to help increase student enrollment in science and technology studies. Since 2000, The Science House at NC State has hosted six Conferences on K-12 Outreach from University Science Departments. In each about 70 participants from NC and other states have gathered to discuss themes ranging from Equity in Science Education to Bringing the Science of the Laboratory into the K-12 Classroom. The Proceedings of the Conferences are available at www.science-house.org/conf The Proceedings report ways in which scientists can support K-12 education and models of how different universities have responded to the needs of schools, teachers and students. We will summarize outcomes of the Conferences

and discuss how successful K-12 science outreach projects are created and sustained.

[1]Supported by the Burroughs Wellcome Fund and the National Science Foundation

11:57 AM

NC.00006 - Impact of Teacher and Student Involvement on Furthering Research Goals[1], *DEBORAH ROUDEBUSH, West Springfield High School, KENNETH MCFARLANE, Hampton Univeristy, LIPSS COLLABORATION* — Hampton University's Center for Particle Physics (CPP) has a long history of successful utilization of the contributions of both high school classroom teachers and undergraduate students in furthering research goals. This talk will focus on the significant contributions that Roudebush made to the construction of the TRT for the ATLAS detector at CERN as a Lead Teacher for the Hampton University Center of the QuarkNet program. Roudebush most recently developed simulations for proof of concept with the LIPSS project under the auspices of the Research Experiences for Teachers (RET) program at Hampton University. Important contributions made by students will also be highlighted.

[1]This work was supported by Hampton University and the National Science Foundation.

12:09 PM

NC.00007 - Assessment of the benefits of a summer undergraduate research program for physics and chemistry majors, *CHRIS HUGHES, GINA MACDONALD, James Madison University* — Presently at James Madison University, there are slightly more than 100 physics majors and 150 chemistry majors. Each summer, a significant fraction of these students participate in either the chemistry or interdisciplinary materials science Research Experiences for Undergraduates (REU) program on campus. This provides a large pool of students from which to draw data comparing the influence of undergraduate research on both classroom performance and attitudes toward science as a profession. By analyzing the grade point averages of chemistry and physics majors, we have shown slightly larger increases from spring semester to fall semester for students who participated in the REU than those who did not. We have also measured changes in attitudes using surveys of the students both at the beginning and at the end of the summer experience. An analysis of these surveys will be presented.

12:21 PM

NC.00008 - Radioactivity of Consumer Products, *DAVID PETERSON, DEREK JOKISCH, PHILIP FULMER, Francis Marion University* — A variety of consumer products and household items contain varying amounts of radioactivity. Examples of these items include: FiestaWare and similar glazed china, salt substitute, bananas, brazil nuts, lantern mantles, smoke detectors and depression glass. Many of these items contain natural sources of radioactivity such as Uranium, Thorium, Radium and Potassium. A few contain man-made sources like Americium. This presentation will detail the sources and relative radioactivity of these items (including demonstrations). Further, measurements of the isotopic ratios of Uranium-235 and Uranium-238 in several pieces of china will be compared to historical uses of natural and depleted Uranium. Finally, the presenters will discuss radiation safety as it pertains to the use of these items.

12:33 PM

NC.00009 A 1-dim Formulation of Modified Newtonian Dynamics, *RONALD MICKENS, Clark Atlanta University* — In 1983, Mordehai Milgrom published three papers providing reasons why dark matter is not required to explain galactic rotation curves (Astrophysical Journal, Vol. 270, 365-389). His explanation was based on a modified Newtonian dynamics (MOND). We examine a specific MOND and solve the equations of motion for four 1-space dimension problems: the free particle, a particle acted on by a constant force, a particle under the influence of linear damping, and the simple harmonic oscillator. Our MOND allows the first three problems to be solved exactly. These calculations indicate that our formulation of MOND may give the correct proper extension of standard nonrelativistic Newtonian dynamics.

SESSION P GRADUATE SCHOOL OPPORTUNITIES

College of William & Mary, Tucker Hall, Rooms 215/216
Chair: Marc Sher (College of William & Mary)
Saturday, November 11, 2006 12:45 PM - 2:00 PM

12:45 PM

PA.00001 - Graduate School Opportunities — An informal luncheon session is planned for undergraduates who attend to offer guidance on the best strategies for applying and gaining acceptance to graduate physics programs. Remarks by faculty members with experience advising majors and/or experience in evaluating applications to regional physics graduate programs will be followed by an informal question and answer session. Undergraduate physics majors with thoughts of continuing to graduate school are strongly encouraged to attend. SESAPS and the National Society of Black Physicists (NSBP) are co-sponsoring this session.

Notes:

Notes:

Epitome of the 2006 Southeastern Section Meeting of the American Physical Society

18:00 - 20:00 WEDNESDAY EVENING
8 November 2006

AA **Registration**

8:30 THURSDAY MORNING
9 November 2006

BA **Solid State NMR Invited Session**
Vold, Wu, Yesinowski, Reyes
Empire A/B

BB **Nuclear Physics I**
Jamestown

BC **Atomic, Molecular, Optical**
Yorktown

10:45 THURSDAY MORNING
9 November 2006

CA **Jefferson Lab: The First Ten Years Invited Session**
Gross, Ent, Williams
Empire A/B

CB **Materials I**
Jamestown

CC **Theory, General**
Yorktown

14:00 THURSDAY AFTERNOON
9 November 2006

DA **Bio/Nanophysics Invited Session**
Dwyer, Goldner, Keppel
Empire A/B

DB **Recent Advances in High Energy Invited Session**
Spanier, Hirosky, Baer
Jamestown

DC **Nuclear Physics II**
Yorktown

16:15 THURSDAY AFTERNOON
9 November 2006

EA **Searching for Gravitational Waves Invited Session**
O'Reilly, Cadonati, Mueller, Lantz
Empire A/B

EB **High Energy Physics I**
Jamestown

EC **Nanoscience**
Yorktown

20:00 THURSDAY EVENING
9 November 2006

FA **Energy Challenges for 21st Century Invited Session**
Gupta, Hirsch
Empire A/B

8:00 FRIDAY MORNING
10 November 2006

GA **Recent Advances in Neutrino Physics Invited Session**
Nelson, Vogelaar, Link, Young
Empire A/B

GB **Biophysics**
Jamestown

8:00 - 10:00 FRIDAY MORNING
10 November 2006

GC **Poster Session**
Empire C

10:15 FRIDAY MORNING
10 November 2006

HA **Jefferson Lab: Plans for the Future Invited Session**
Lung, Elouadrhiri, Dzierba
Empire A/B

HB **Gravity/Astrophysics**
Jamestown

HC **Materials II**
Yorktown

13:00 FRIDAY AFTERNOON
10 November 2006

JA **Tour of Jefferson Laboratory**

17:30 FRIDAY AFTERNOON
10 November 2006

KA **SESAPS Business Meeting**
Jamestown

18:30 FRIDAY EVENING
10 November 2006

LA **SESAPS Banquet**
Bogden
Empire A/B/C

8:30 SATURDAY MORNING
11 November 2006

MA **Rising Above the Gathering Storm Invited Session**
Rooney, Howes, Mulvey, Clark
Empire A/B

MB **Nuclear Physics III**
Huntington

MC **High Energy Physics II**
Empire C

10:45 SATURDAY MORNING
11 November 2006

NA **Astronomy and Astrophysics Invited Session**
Hajian, Bloom, Nysewander, Scully
Empire A/B

NC **Physics Teaching**
Empire C

12:45 SATURDAY AFTERNOON
11 November 2006

P **Graduate School Opportunities**
College of William & Mary
Tucker Hall, Room 215/216

APS physics

SESAPS 2006