77th Annual Meeting of the Southeastern Section of the APS
Baton Rouge, Louisiana
http://www.aps.org/meetings/meeting.cfm?name=SES10
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and the movements of magma at depth. Satellite radar data indicate that Okmok volcano, Alaska, subsided more than a meter during its eruption in 1997. These data from radar satellites can map this deformation for an entire volcanic system and ground-based seismic instruments can image the internal structure. Deformation models simulate this internal structure, subjected to the forces of magma movements, and provide the quantitative linkage between the observed surface deformation and the movements of magma at depth. Satellite radar data indicate that Okmok volcano, Alaska, subsided more than a meter during its eruption in 1997. The deformation pattern suggests magma extraction from a shallow reservoir. New seismic tomography reveals two weak zones within Okmok. The shallow weak zone corresponds to a region of fluid-saturated rock that extends from the caldera surface to a depth of 2 km. The deep weak zone indicates the presence of the magma chamber at a depth of about 4 km. We construct finite element models (FEMs) to simulate deformation caused by magma extraction from a chamber that is surrounded by a viscoelastic rind of country rock. Thermal models define the brittle-ductile transition and thickness of the viscoelastic rind. This assemblage, which represents the deep weak zone, is embedded in an elastic model domain that includes a shallow weak zone filling the caldera. Because the predicted surface deformation is the combined elastic and viscous response to magma extraction, these viscoelastic FEMs reduce the required magma chamber depressurization (compared to strictly elastic models) to within lithostatic constraints, while simultaneously predicting the magnitude and pattern of deformation observed with satellite radar data. More precisely, the satellite radar data are best predicted by an FEM simulating a rind viscosity of 7.5×10^16 Pa·s and a magma flux of ~10^16 kg/d from the magma chamber. Additionally, the shallow weak zone provides a co-eruption stress regime and neutral buoyancy horizon that support lateral magma propagation from the central magma reservoir to the observed lava extrusion near the rim of the caldera.

Thursday, October 21, 2010 8:30AM - 10:30AM

8:30AM BA.00001 The role of physics in atmospheric, ocean and Earth science

FRANCO EINAUDI,

NASA — The Earth system is a very complex system made of the Atmosphere, the Biosphere, the Hydrosphere, the Cryosphere and the solid portion of the Earth’s surface. These components interact with each other in very complex highly nonlinear ways. Advances in remote sensing techniques and computational capabilities have allowed Earth system science to make substantial advances and contributions in the fields of geophysical fluid dynamics, chemistry, biology, cloud and aerosols dynamics and interactions, and computational science. Some of the major scientific achievements will be described. The scientific issues facing our field will be discussed, including challenges of climate and feedback mechanisms. Throughout the presentation, emphasis will be given to the physics behind our science.

9:00AM BA.00002 Mesoscale eddies and vertical mixing in the ocean

ANNALISA BRACCO, EAS - Georgia Tech — Mesoscale eddies are fundamental players in the vertical transport and mixing in the ocean. Here we investigate the vertical velocities associated with coherent vortices using a high-resolution primitive-equation model in an idealized configuration and in a simulation of the Gulf of Mexico. In the vortex cores and inside intense vorticity filaments, the motion is strongly ageostrophic, and vertical velocities associated with vortices can reach unexpected magnitudes and levels of spatial complexity. Mesoscale anticyclones appear as “islands” of increased penetration of wind energy into the ocean interior. The wind energy injected at the surface is transferred at depth through the generation and subsequent straining effect of Vortex Rossby Waves (VRWs), and through near-inertial internal oscillations trapped inside anticyclonic eddies.

1 NSF OCE-0751775

9:30AM BA.00003 Tracking the movement of magma through the crust in the East African rift

CYNTHIA EBINGER, University of Rochester — Although fault and magmatic processes have achieved plate spreading at mid-ocean ridges throughout Earth’s history, intense volcano-tectonic rifting episodes have rarely been observed. A 65 km-long segment of the subaerial Red Sea rift in Ethiopia experienced a major volcano-tectonic rifting episode in September 2005. Incipient seafloor spreading centers in the Afar rift are surrounded by continental crust and mantle lithosphere stretched and intruded during the past 30 Ma as Africa and Arabia have rifted apart above a mantle plume. We use seismic data and complementary space-based geodetic and remote sensing data to determine the length and timescales of magmatism and faulting, the partitioning of strain between faulting and magmatism, and their implications for the maintenance of along-axis segmentation. Most of the magma for the initial and subsequent 12 intrusions was sourced from the center of the Dabbahu-Manda Hararo rift segment. Strain is accommodated primarily by axial dike intrusions fed from mid-segment magma chamber(s). These findings show that episodic (approximate century interval), rapid opening of discrete rift segments is the primary mechanism of plate boundary deformation. The length scale (~65 km) and intensity of crustal deformation (~6 m), as well as the volume of intrusive and extrusive magmatism (>3 cubic km) provokes a re-evaluation of seismic and volcanic hazards in subaerial rift zones.

10:00AM BA.00004 Exploring the interior of an active volcano with deformation models

TIMOTHY MASTERLARK, The University of Alabama — The migration of restless magma within an active volcano produces a deformation signature at the Earth’s surface. The internal structure of a volcano and specific movements of the magma control the actual deformation that we observe. Data from radar satellites can map this deformation for an entire volcanic system and ground-based seismic instruments can image the internal structure. Deformation models simulate this internal structure, subjected to the forces of magma movements, and provide the quantitative linkage between the observed surface deformation and the movements of magma at depth. Satellite radar data indicate that Okmok volcano, Alaska, subsided more than a meter during its eruption in 1997. The deformation pattern suggests magma extraction from a shallow reservoir. New seismic tomography reveals two weak zones within Okmok. The shallow weak zone corresponds to a region of fluid-saturated rock that extends from the caldera surface to a depth of 2 km. The deep weak zone indicates the presence of the magma chamber at a depth of about 4 km. We construct finite element models (FEMs) to simulate deformation caused by magma extraction from a chamber that is surrounded by a viscoelastic rind of country rock. Thermal models define the brittle-ductile transition and thickness of the viscoelastic rind. This assemblage, which represents the deep weak zone, is embedded in an elastic model domain that includes a shallow weak zone filling the caldera. Because the predicted surface deformation is the combined elastic and viscous response to magma extraction, these viscoelastic FEMs reduce the required magma chamber depressurization (compared to strictly elastic models) to within lithostatic constraints, while simultaneously predicting the magnitude and pattern of deformation observed with satellite radar data. More precisely, the satellite radar data are best predicted by an FEM simulating a rind viscosity of 7.5×10^16 Pa·s and a magma flux of ~10^16 kg/d from the magma chamber. Additionally, the shallow weak zone provides a co-eruption stress regime and neutral buoyancy horizon that support lateral magma propagation from the central magma reservoir to the observed lava extrusion near the rim of the caldera.

Thursday, October 21, 2010 8:30AM - 10:30AM

8:30AM BB.00001 LIGO and the bright future of gravitational wave astronomy

LISA BARSOTTI, LIGO-MIT — The three LIGO gravitational wave detectors in the Livingston and Hanford Observatories have operated at their design sensitivity until October 2007 by collecting one year of triple coincidence data. An upgrade of the two 4 km detectors further improved their sensitivity, and new science data were collected until October 2010 in the S6 science run. The enhanced detectors not only reached their best sensitivity ever, but also proved the technology which will be implemented in the Advanced LIGO detectors. Since October 2010, both the LIGO sites will see a major upgrade which will culminate in the next few years with about 10 times more sensitivity, starting the era of gravitational wave astronomy. In this talk, the recent performance and results of the S6 science run will be presented, together with an overview of the upcoming upgrades which will bring Advanced LIGO to detect gravitational waves.

9:00AM BB.00002 Searches for Gravitational Waves in LIGO Data

ANDREW LUNDGREN, Penn State — I will discuss the challenges involved in searches for gravitational waves in LIGO data. I will give an overview of some of the sources searched for like pulsars, supernovae, black holes and binary black holes. I will also discuss the challenges posed by non-stationary and non-Gaussian noise transients, and methods for improving confidence in a prospective detection.

9:30AM BB.00003 Introducing NINJA: A Gravitational Wave Community Project

DEIRDRE SHOE-MAKER, Georgia Tech — A world-wide network of gravitational wave detectors is operational. Fortunately one of the most important sources of gravitational waves, the coalescence of two black holes, is now routinely computed by numerical relativity. The Numerical Injection Analysis Project (NINJA) was formed to study the sensitivity of gravitational-wave analysis pipelines to numerical simulations of waveforms and foster close collaboration between numerical relativists and data analysts. This talk will summarize the results of the first NINJA project and introduce the goals of the second.

3 On behalf of the NINJA Collaboration
10:00AM BB.00004 LISA Overview, GUIDO MUELLER, University of Florida — The Laser Interferometer Space Antenna (LISA) will complement the ground-based interferometric gravitational wave detectors such as LIGO and VIRGO the same way infrared telescopes complement optical telescopes. LISA will measure gravitational waves in the mHz frequency range where for example super-massive black hole mergers release most of their energy. It will consist of three spacecraft in a heliocentric orbit trailing earth by 20 deg. The three spacecraft will be separated by 17s light travel time and will form a near equilateral triangle. Two subsystems form the core of LISA. Free falling proof masses inside each spacecraft will be used as gravitational reference sensors (GRS). The residual forces on these proof masses will have to be in the order of nN/rtHz in the LISA band. The interferometry measurement system (IMS) will measure changes in the distances between these free falling proof masses with pm/rtHz sensitivity. I will briefly describe the overwhelming science case for LISA, discuss the GRS and the status of the LISA Pathfinder (LPF) mission which is scheduled to launch late 2012. LPF’s only purpose is to test this subsystem for LISA. I will then focus on the IMS, present the concept and discuss ongoing experimental research in the US and in Europe.

Thursday, October 21, 2010 8:30AM - 10:06AM — Session BC Magnetism, Metal-Insulator Transitions, and Quantum Dots Nicholson Hall 118

8:30AM BC.00001 Doping Dependence of Structural, Electrical and Magnetic Properties of Sr$_3$(Ru$_{1-x}$Mn$_x$)$_2$O$_7$ Single Crystals, BIAO HU, Department of Physics and Astronomy, Louisiana State University, GREGORY T. MC-CANDLESS, Department of Chemistry, Louisiana State University, E.W. PLUMMER, RONGYING JIN, Department of Physics and Astronomy, Louisiana State University — We have studied the doping dependence of structural, electrical and magnetic properties of Sr$_3$(Ru$_{1-x}$Mn$_x$)$_2$O$_7$ with 0.0$\leq x \leq$0.1. Our single crystal X-ray diffraction refinements show that the Ru06 octahedron rotates about 7° in undoped Sr$_3$Ru$_2$O$_7$. With the partial substitution of Ru by Mn, the rotation is gradually attenuated. Correspondingly, the electrical and magnetic properties of Sr$_3$(Ru$_{1-x}$Mn$_x$)$_2$O$_7$ vary with x. We will discuss the correlation between structure and physical properties in this system.

8:42AM BC.00002 Magnetotransport Properties of Thin C-Fe Films, JOSEPH PRESTIGIACOMO, Louisiana State University Department of Physics and Astronomy, KATHERINE LUSKER, Louisiana State University Department of Chemistry, YIMIN XIONG, SHANE STADLER, AMAR KARKI, DAVID YOUNG, Louisiana State University Department of Physics and Astronomy, JAYNE GARNOCZ, Louisiana State University Department of Chemistry, PHILIP ADAMS, Louisiana State University Department of Physics and Astronomy — The magnetotransport properties of C-Fe films formed by e-beam vapor deposition onto glass substrates are presented in the temperature region of 2 K to 300 K. Hall effect measurements exhibit a significant anomalous Hall voltage whose magnitude increases with increasing temperature. Measurements of the ordinary Hall coefficient in 10 nm-thick films give a charge carrier density ranging from n ~ 3.0 x 10$^{20}$ m$^{-3}$ at 2 K to approximately half that value at 290 K. A comparison between anomalous Hall effect and parallel field magneto-optic Kerr effect measurements reveal a highly anisotropic coercive field with the easy direction lying in the plane of the film. The films have an isotropic linear positive magnetoresistance (LPMR) beyond their saturation magnetization.

8:54AM BC.00003 The Anomalous Hall Effect in Ultra-Thin Amorphous CNi3 Films, YIMIN XIONG, PHILIP ADAMS, Department of Physics and Astronomy, Louisiana State University, GIANLUIGI CATELANI, Department of Physics, Yale University — The anomalous Hall resistance in homogeneous CNi$_3$ films with sheet resistance near the quantum resistance was studied. Tunneling measurements show that the saturation behavior is commensurate with the emergence of the 2D Coulomb gap, suggesting that e-e interactions mediate the high-disorder phase. The saturation of anomalous Hall resistance is associated with the crossover from the weak- localization regime to that of a 2D correlated insulator. In the weak-localization region, where the sheet conductance G > e$^2$/h, the anomalous Hall resistance of the films increases with increasing disorder and the Hall conductance scales as G$_{xy}$ ∝ G$^w$ with ϕ = 1.6. However, at sufficiently high disorder the system begins to enter the 2D correlated insulator regime, at which point the Hall resistance R$_{xy}$ abruptly saturates and the scaling exponent becomes ϕ = 2. The crossover is also clearly evident in the scaling behavior of the Hall conductivity as well as in the tunneling density of states.

9:06AM BC.00004 Structure and Magnetism of FeAl(110) Surface Phases, MATTHEW PATTERSON, Department of Physics and Astronomy, Louisiana State University, ORHAN KIZILKAYA, CHALLA KUMAR, Center for Advanced Microstructures and Devices, Louisiana State University, RICHARD KURTZ, PHILLIP SPRUNGER, Department of Physics and Astronomy and Center for Advanced Microstructures and Devices, Louisiana State University — We have studied the correlation between FeAl(110) surface structures and surface ferromagnetism using X-ray absorption (XAS), X-ray magnetic circular dichroism (XMCD), and scanning tunneling microscopy (STM). FeAl(110) is cleaned by repeated cycles of Ne+ sputtering and annealing and exhibits a variety of surface reconstructions as a function of annealing temperature. Bulk magnetometry shows that single-crystal FeAl is paramagnetic at room temperature. However, it was found by XMCD measurements at the Fe L2,3 edge that the surface phase formed by sputtering without annealing exhibits ferromagnetism, and that the small induced magnetization vanishes both with oxidation of the surface and with reconstruction. The observed induced magnetization is discussed in light of STM measurements of the sputtered and oxidized surfaces and prior studies of the morphology of the FeAl(110) surface reconstructions.

9:18AM BC.00005 Nonreciprocal switching of VO$_2$ thin films on microstructured surfaces, CHARLES ADAMS, Vanderbilt Univ., ISMAIL KARAKURT, Isik Univ., PAUL LEIDERER, JOHANNES BONEBERG, Konstanz Univ., RICHARD HAGLUND, Vanderbilt Univ. — Vanadium dioxide is a strongly correlated electron material that undergoes an insulator-to-metal transition at approximately 340 K, with a corresponding large change in its optical and electronic properties. By depositing a VO$_2$ thin film on a planar hexagonal close-packed array of 1.54 μm diameter silica microspheres, we constructed a laser-triggered thin film optical switch that exhibits different fluence thresholds for the insulator-metal transition (IMT) depending on the direction of illumination. The IMT was triggered by a ns Nd:YAG laser (532 nm) from two directions normal to the substrate while monitoring the transmission with a near-infrared diode laser. Due to the focusing effects of the microspheres, the fluence required for switching the VO$_2$ was 2.4 times higher when the switching laser was incident from the top side of the array than from the microsphere (bottom) side. Through both the experiments and simulations, we find evidence for strong nonlinear near-field absorption in the VO$_2$.  

Supported in part by Isik Univ. (BAP-06A10), and the National Science Foundation (NSF) (EECS-0801985).

9:30AM BC.00006 Low-power laser induced metal-insulator transition in gold::vanadium dioxide nanoarrays, DAVON W. FERRARA, EVAN R. MACQUARRIE, JOYEEA NAG, RICHARD F. HAGLUND, Department of Physics and Astronomy, Vanderbilt University — Vanadium dioxide (VO$_2$) is a strongly correlated electron material with a well-known semiconductor-to-metal transition (SMT) that can be induced thermally, optically, or electrically. By coating lithographically prepared arrays of gold nanoparticles (NPs) of diameter 140 nm with a 60 nm thick film of VO$_2$ by pulsed laser deposition, hybrid Au::VO$_2$ structures were created. Due to the sensitivity of the Au particle-plasmon resonance (PPR), a temperature dependent shift in the PPR can be generated by switching the VO$_2$ from one phase to another, creating a tunable plasmonic metamaterial. To study the low-power switching characteristics of these structures, transient absorption measurements were made using a mechanically shuttered 785 nm pump laser, corresponding to the PPR resonance of the Au NPs, and 1550 nm CW probe. Results show that the presence of Au NPs significantly lowers the threshold laser power required to induce the SMT. Measurements on arrays of different grating constants (350 nm and 500 nm) support the hypothesis that the particles are acting as “nano-radiators” that absorb and redheat thermal energy by scattering light back into the film. Finite element modeling was performed to better understand the complex thermodynamics of the structure.
9:42AM BC.00007 Cu/CuOx Nanoclusters on ZnO(1010): Electronic, Catalytic, Morphological Structure. ZIYU ZHANG, MATTHEW PATTERSON, MAOMING REN, YAROSLAV LOSOVOY, JOHN FLAKE, RICHARD KURTZ, PHILLIP SPRUNGER, Louisiana State University — ARUPS, STM, and EELS has been used to study the electronic, atomic and chemical structure of Cu and CuO nanoclusters on non-polar ZnO(1010) surface. Within the backdrop of developing high performance CO2 reduction catalyst (methanol production), our studies show that higher yield rate are found for Cu(I) surface species. ARUPS results from nanocluster CuOx/ZnO reveals that the oxidation process is highly dependent on the cluster size (smaller size. Moreover, CO adsorption (BE and vibrational) are distinctly different between Cu and CuO nanoclusters supported on ZnO. Reaction studies confirm that methanol production is 4 times higher on partially oxidized Cu nanoclusters. Photoemission shows a small amount of Cu(II) even upon repeated oxidation/annealing processes, indicating a preferential stability of Cu(I) in the supported nanoclusters, due to interfacial effects with the substrate. This talk will include results from EELS/TPD and STM/AFM studies to better elucidate the chemical adsorption and intermediates as a function of CuOx size and structure.

9:54AM BC.00008 Kondo temperature in a quantum dot. SEUNGJOO NAH, MICHAEL PUSTILNIK, Georgia Institute of Technology — The dependence of the Kondo temperature in a quantum dot on the gate voltage is studied in the Coulomb blockade regime. Due to the finite size of the quantum dot, the Kondo temperature is greatly enhanced compared with that in the Anderson impurity model.

Thursday, October 21, 2010 10:45AM - 12:45PM – Session CA Dynamics in Living Cells Nicholson Hall 119

10:45AM CA.00001 Observing the conformation of individual SNARE proteins inside live cells. KEITH WENINGER, North Carolina State University — Protein conformational dynamics are directly linked to function in many instances. Within living cells, protein dynamics are rarely synchronized so observing ensemble-averaged behaviors can hide details of signaling pathways. Here we present an approach using single molecule fluorescence resonance energy transfer (FRET) to observe the conformation of individual SNARE proteins as they fold to enter the SNARE complex in living cells. Proteins were recombantly expressed, labeled with small-molecule fluorescent dyes and microinjected for in vivo imaging and tracking using total internal reflection microscopy. Observing single molecules avoids the difficulties of averaging over unsynchronized ensembles. Our approach is easily generalized to a wide variety of proteins in many cellular signaling pathways.

11:15AM CA.00002 Amyloid Nucleation and Assembly Dynamics1. KEITH BERLAND, Emory University — The nucleation and growth mechanisms in amyloid forming materials are of high interest due to their importance in human diseases and also due to their potential applications as functional nano-materials. While much is known about the secondary structure of amyloids materials, the nucleation mechanism and self-assembly processes remain poorly understood. We have recently identified unstructured intermediates play a critical role in early nucleation and assembly of amyloid nanotubes in model peptide systems, and resolved that initial assembly proceeds via monomer addition to the ends of elongating tubes. We will discuss our current understanding of these assembly pathways, and discuss recent measurements highlighting dynamic structural evolution as nanostructures mature following initial assembly.

1Supported by NSF award MCB 0347124

11:45AM CA.00003 Noise and heterogeneity in bacterial communication1. STEPHEN HAGEN, Physics Department, University of Florida, Gainesville FL 32611 — Many bacterial species engage in a sophisticated chemical communication behavior known as quorum sensing: Individual cells release small diffusible molecules into their environment while simultaneously detecting the local concentration of these molecules. Important collective behaviors of the bacterial population are triggered once the signal concentration accumulates to a certain level. Although quorum sensing is widespread in microbiology, the physical environment of bacteria is often very heterogeneous and diffusion may be inefficient. Meanwhile the genetic circuitry that generates and detects the chemical signal is microscopic and subject to stochasticity. This raises interesting physical questions about how much information is actually carried by these chemical signals, and what an individual cell can learn about its environment through this mechanism. I will present a general introduction to quorum sensing with emphasis on our experimental studies of the role of noise and microenvironment on this phenomenon.

1Supported by NSF award MCB 0347124

12:15PM CA.00004 Quantifying the Effect of DNA Packaging on Gene Expression Level. HAROLD KIM, Georgia Institute of Technology — Gene expression, the process by which the genetic code comes alive in the form of proteins, is one of the most important biological processes in living cells, and begins when transcription factors bind to specific DNA sequences in the promoter region upstream of a gene. The relationship between gene expression output and transcription factor input which is termed the gene regulation function is specific to each promoter, and predicting this gene regulation function from the locations of transcription factor binding sites is one of the challenges in biology. In eukaryotic organisms (for example, animals, plants, fungi etc), DNA is highly compacted into nucleosomes, 147-bp segments of DNA tightly wrapped around histone protein core, and therefore, the accessibility of transcription factor binding sites depends on their locations with respect to nucleosomes - sites inside nucleosomes are less accessible than those outside nucleosomes. To understand how transcription factor binding sites contribute to gene expression in a quantitative manner, we obtain gene regulation functions of promoters with various configurations of transcription factor binding sites by using fluorescent protein reporters to measure transcription factor input and gene expression output in single yeast cells. In this talk, I will show that the affinity of a transcription factor binding site inside and outside the nucleosome controls different aspects of the gene regulation function, and explain this finding based on a mass-action kinetic model that includes competition between nucleosomes and transcription factors.

Thursday, October 21, 2010 10:45AM - 12:45PM – Session CB What Can We Do About the Dearth of Qualified High School Physics Teachers (and High School Physics Students)? Nicholson Hall 109

10:45AM CB.00001 National Task Force on Teacher Education in Physics. MONICA PLISCH, American Physical Society — Except for a handful of isolated pockets of excellence, the national system of preparing physics teachers is largely inefficient, mostly incoherent, and massively unprepared to deal with the current and future needs of the nation’s students. Physics departments, schools of education, university administrators, school systems, state agencies, the federal government, as well as business and foundations, have indispensable collaborative roles to play so that every high school student has the opportunity to learn physics with a qualified teacher.
11:45 AM CB.00003 The PhysTEC Teacher Education Program at FIU¹, LAIRD KRAMER, Florida International University — The FIU PhysTEC Project is an integral component of the Physics Department’s educational transformation that has led to more than a ten-fold increase in majors. The transformation seeks to increase the quality and quantity of physics majors and future physics teachers, including those from historically underrepresented groups. Elements of the effort include transformed introductory physics courses, establishment of a physics research and learning community, engagement of stakeholders spanning high school through the university administration, and advocacy by a physics education research group. The PhysTEC Project supports future physics teachers through a Learning Assistant program coupled to newly revised secondary education programs. The Learning Assistant program is an experiential program that recruits new students into teaching careers while providing a mechanism for transforming courses - undergraduates experience the rewards and intellectual challenges of teaching through providing interactive engagement learning experiences for their peers in introductory physics courses. Students that continue in the program enroll in a multidisciplinary teacher preparation program and may receive significant financial support. FIU is a minority-serving urban public research institution in Miami, Florida serving over 39,000 students, of which 64% are Hispanic, 13% are Black, and 56% are women. Programmatic strategies and impacts of the program will be provided.

¹This work supported by PhysTEC and NSF Award #0808214.

12:15PM CB.00004 “But you’re just a physics booster!” — Why political advocacy for high school physics is crucial, PAUL COTTLE, Florida State University — There is no shortage of research-based arguments supporting the importance of high school physics. A study from the University of South Florida demonstrates the importance of high school physics for the preparation of future STEM professionals [1]. A white paper from the National Academy of Education [2] states that the usual biology-chemistry-physics sequence in high school is “out of order” and points out that students in 9th grade biology classes are taught concepts that make no sense to them because they “know little about atoms and next to nothing about the chemistry and physics that can help them make sense of these structures and their functions.” Nevertheless, in Florida the high school physics-takes rate has been declining for several years and a large fraction of the International Baccalaureate programs do not even offer IB Physics. I will argue that physicists must collectively advocate in the political arena for the expansion and improvement of high school physics. I will also provide a few examples of collective actions by scientists that may have influenced the formulation of the new high school graduation requirements in Florida. Finally, I will argue that we must lobby our colleagues in the Colleges of Education to devote their scarce resources to recruiting and training teachers in the physical sciences.


Thursday, October 21, 2010 10:45AM - 12:45PM
Session CC Gravitation: LIGO and LISA
Nicholson Hall 118

10:45AM CC.00001 Developing LIGO Detector Characterization Tools and Methods, CESAR COSTA, Louisiana State University — Laser Interferometric Gravitational-Wave Observatory (LIGO) has been in constant process of improvement to achieve its main goal: the detection of gravitational waves (GWs). For the current science run (S6), improved control systems have been installed in order to increase the instrument sensitivity. The LIGO Detector Characterization (DetChar) Group works to understand how such devices and environmental sources could affect the GW channel, specially when they contaminate measurements by introducing spurious signals. To decrease false alarm rates DetChar monitors several auxiliary channels in order to diagnose environmental and instrumental glitches which can produce GW signal-like events. This improves the data quality for GW searches, and also informs commissioners about instrumental issues. This talk describes the methodology that we have been applying to LIGO Detector Characterization, specially glitch hunting and monitoring tools.

10:57AM CC.00002 Global Noise Subtraction in LIGO Interferometers, RYAN DEROSA, Louisiana State University, LIGO COLLABORATION — In order to provide local seismic isolation and reduce the feedback control signals in the 4 km LIGO detectors an active feed forward system has been in use since 2004. As a modification to this scheme a network of seismometers has been used to create global feed forward signals, resulting in increased seismic isolation below 3 Hz. This additional isolation has provided increased duty cycle and sensitivity. The force applied to each optic to maintain cavity resonance has also been reduced, producing less transient noise in the data stream.

11:09AM CC.00003 Data quality and vetoes in searches for gravitational waves in LIGO data, JACOB SLUTSKY, LIGO-VIRGO SCIENTIFIC COLLABORATION — Searches for gravitational waves with LIGO are hindered by the presence of transient detector noises not of astrophysical origin. Interferometric gravitational wave detectors are sensitive to a wide variety of these transient events, originating both within the detector and from the surrounding environment. The LIGO-Virgo Collaboration has identified a variety of data quality issues that induce false alarms in searches for compact binary coalescences in LIGO data. We define time intervals affected by these effects, and use them as vetoes. These vetoes reduce the false coincidence rate of the searches.

11:21AM CC.00004 Adding an astrophysically motivated detection confidence test, Effective Distance Ratio, to our standard confidence tests for Inspiral Candidate Events, CRISTINA TORRES, LIGO Livingston Observatory, LIGO SCIENTIFIC COLLABORATION¹ — In order to detect gravitational-wave signals from compact binary inspiral systems in the data from the LIGO detectors the LSC-Virgo Compact Binary Coalescence (CBC) group has developed an analysis method based on optimal matched filtering. In order to confirm the possible discovery of gravitational waves, the CBC group has developed a detection checklist intended to validate the statistically significant candidate events produced by the CBC analysis. This checklist is a series of additional tests under active development for integration into our search infrastructure, or a set of “final” quantitative checks geared to corroborating a detection or to identifying a false alarm. We practice this checklist with the loudest candidates found (even if not statistically significant) and with simulated signals. As part of this talk we will present an evolving checklist test, the Effective Distance Ratio, and discuss this tests potential for candidate validation because of simple astrophysical basis. In addition to presenting this test, we will review the standard inspiral candidate validation methodology giving context about where our new confidence test fits into the inspiral search hierarchy.

¹CBC Followup sub-working group
11:33AM CC.00005 Laser Communication for LISA, KENDALL ACKLEY, DYLAN SWEENEY, GUIDO MUELLER, University of Florida — The Laser Interferometer Space Antenna (LISA) is a joint mission between NASA and ESA to detect gravitational wave radiation between 0.1 and 1 Hz by measuring phase fluctuations of laser heterodyne signals. The phase of the signals must be measured to microradian accuracy. For LISA to be successful the distance between the spacecraft (SC) must be measured to meter precision and the clock signals on each SC must be recorded. These functions will be accomplished using the laser links between the SC. Pseudo random noise (PRN) codes will be modulated onto the light and used to measure the light travel delay between the SC. The clock signals on each SC will be frequency up-converted to GHz frequencies, modulated onto the laser links, and sent to the other SC where it will be recorded and used in post-processing to cancel the clock noise. We have tested components of these systems such as frequency up-converters, electro-optic modulators, and photodetectors, as well as the systems themselves to see if they are capable of meeting their performance requirements for LISA. We will discuss the work being completed at UF. This work is supported by NASA Grant NNX09AF99G.

11:45AM CC.00006 Heterodyne Stabilization for the Laser Interferometer Space Antenna (LISA) JOHANNES EICHHOLZ, University of Florida, STEVEN HOCHMAN, ALIX PRESTON, GUIDO MUELLER — LISA is a joint NASA/ESA space mission to detect gravitational waves from 0.1 mHz to 1 Hz generated e.g. by super-massive black hole mergers. Three spacecraft move in a triangular constellation on a heliocentric orbit. Their distances are monitored interferometrically with laser links. LISA detects fluctuations of the 5 million km arm lengths. One-way laser phase measurements between the individual spacecraft in the LISA constellation are used to reconstruct an equal-arm interferometer, cancel the laser phase noise, and extract the gravitational wave information. The 2-20 MHz-frequency laser beat signals must be measured with a sensitivity of 1 ucycle/sqrt(Hz) in order to cancel the laser noise and accurately reconstruct the GW signal. The beat signal phase is measured with a phasemeter. In this presentation, the performance of our phasemeter and its limiting noise sources will be discussed. Methods of mitigating the phase noise, including the application of a post-processing technique and active temperature stabilization, are considered and investigated for their applicability and usefulness to the LISA mission. This work is supported by NASA grant NNX08AG75G.

11:57AM CC.00007 Development and Analysis of Micro-cycle Phase Measurements for LISA DARSA DONELAN, SHAWN MITRYK, SYED REZA, JOSE SANJUAN, GUIDO MUELLER — The Laser Interferometer Space Antenna (LISA) project is a space-based gravitational wave (GW) interferometer designed to measure gravitational radiation in the frequency range from 0.1 mHz to 1 Hz. One-way laser phase measurements between the individual spacecraft in the LISA constellation are used to reconstruct an equal-arm interferometer, cancel the laser phase noise, and extract the gravitational wave information. The 2-20 MHz-frequency laser beat signals must be measured with a sensitivity of 1 ucycle/sqrt(Hz) in order to cancel the laser noise and accurately reconstruct the GW signal. The beat signal phase is measured with a phasemeter. In this presentation, the performance of our phasemeter and its limiting noise sources will be discussed. Methods of mitigating the phase noise, including the application of a post-processing technique and active temperature stabilization, are considered and investigated for their applicability and usefulness to the LISA mission. This work is supported by NASA grant NNX08AG75G.

12:09PM CC.00008 Investigations on a LISA Telescope Spacer AARON SPECTOR, JOSEP SANJUAN, ALIX PRESTON — The Laser Interferometer Space Antenna (LISA) is a space-based mission designed to observe gravitational waves from 0.1 mHz to 1 Hz. Using a triangular constellation of three spacecraft separated by 5x10^7 km, LISA will be able to detect the length changes between the spacecraft induced by gravitational waves. These length changes can be detected with pm/rtHz sensitivity using laser interferometry. Each spacecraft must contain two telescopes that can transmit and receive light between spacecraft. To expand and collimate the beam, a two-mirror system was designed with a primary and secondary mirror separated by a spacer. The noise requirements for LISA demand that the telescope spacer must be extremely stable. Two designs, on-axis and off-axis, are being considered for the telescope spacer. Various materials are also being examined. An on-axis silicon carbide telescope test structure was built to assess the stability of this configuration. A Michelson Interferometer was used to monitor length changes of the test structure while being cooled to space-like temperatures. Stability measurements are currently being made by locking the telescope laser to a cavity mounted on the test structure and then the beat note between the telescope laser and another cavity-locked laser is observed. A beat note between another laser locked to the Doppler-free spectral lines of iodine and the telescope laser will be used to determine the long term stability of the test structure.

12:21PM CC.00009 The effective source approach to the self-force problem, PETER DIENER, Louisiana State University — Extreme Mass Ratio In-spirals of compact objects into super massive black holes are expected to be a very important source of gravitational waves for LISA. Perturbation techniques have traditionally been employed. Here the small compact object is treated as a point particle moving on a perturbed geodesic in an exact black hole spacetime. Gravitational waves are emitted due to the particle motion which are then back scattered off the curvature of the background space-time and interact with the particle itself at a later point in the orbit: The so called self-force problem. Traditionally, to solve this problem, the field equations have been evolved with a singular delta-source, yielding a singular field at the location of the particle. To calculate the self-force the singular field then has to be carefully subtracted. We present results for the calculation of the self-force for a scalar point charge moving in circular orbits around a non-rotating black hole using a new technique where the singularity of the point particle is subtracted from the source before the evolution is done, resulting in a regular field at the particle location from which the self-force can easily be calculated.

12:33PM CC.00010 A new look at Gravity Waves, RICHARD KRISKE, University of Minnesota — The author has previously proposed that perhaps there needs to be a look at the CMBR as being a measure of curvature. It seems that a valid theory of curved space in a four dimensional space time would allow the Red Shift to occur due to the changing orientation of the time dimension that would slowly point more and more away from any observer at any point until like the Earth’s horizon in two curved space dimensions to point away from the observer and give the sharp cut off of the horizon. A three curved space dimensional cut off would result in the appearance of increasing velocity as the distance from the observer increases and this without the Big-Bang theory. What would one observe for Gravitational waves on this surface? The three space dimensions would wiggle and the time dimension (which is not curved) would move to stay perpendicular to this motion, giving odd accelerations and I predict a different Microwave signal. Perhaps a nonuniformity in the Back Ground radiation that would shift over time.

Thursday, October 21, 2010 10:45AM - 12:33PM Session CD Nuclear Physics, Mesons, and Quantum Gravity Nicholson Hall 108
10:45AM CD.00001 The $\beta$ decay studies of $^{75}$Cu using LeRBSS, S. ILYUSHKIN, J. WINGER, K. RYKACZEWSKI, C. GROSS, J. BATCHELDER, L. CARTEGNI, I. DARBY, R. GRZYWACZ, J. HAMILTON, A. KORGUL, W. KROLAS, S. LIDDICK, C. MAZZOCCHI, S. PADGETT, A. PIECHACZEK, M. RAJABALI, D. SHAPIRA, E. ZGANJAR — The $\beta$ decay of $^{75}\text{Cu}$ ($t_{1/2} = 1.222(8)\text{s}$) to levels in $^{75}\text{Zn}$ has been studied at the Holifield Radioactive Ion Beam Facility at Oak Ridge National Laboratory. The $\gamma$ and $\beta^+$ data were collected using the Low-energy Radioactive Ion Beam Spectroscopy Station making use of the high-resolution isobar separator. This resulted in considerable information on the previously unknown level structure of $^{75}\text{Zn}$ with some 120 $\gamma$-ray transitions placed in a level scheme containing 59 levels including two states above the neutron separation energy. A previously unknown $1/2^-$ isomeric state at 127 keV is proposed. In addition, spins and parities of several states are proposed based on the observed decay pattern. These states can be explained in terms of coupling in the $1g_{9/2}$ and $2p_{1/2}$ orbitals to protons in the $1g_{9/2}$ and $2p_{3/2}$ orbitals. Results of $\beta$ decay studies of $^{75}\text{Cu}$ will be presented.  

1This work was supported under US DOE grants DE-FG02-96ER41006, DE-AC05-00OR22725, DE-FG02-96ER40983, DE-AC05-06OR23100, and the NNSA through DOE Cooperative Agreement DEFC03-03NA01043.

10:57AM CD.00002 The Array for Nuclear Astrophysics Studies with Exotic Nuclei, L.E. LINHARDT, J.C. BLACKMON, M. MATOS, L.L. MONDELLO, E.F. ZGANJAR, Louisiana State Univ., E. JOHNSON, G. ROGAČEVIĆ, I. WIJDENÖVER, Florida State Univ., LOUISIANA STATE UNIV. TEAM, FLORIDA STATE UNIV. TEAM — The Array for Nuclear Astrophysics Studies with Exotic Nuclei (ANASEN) is a charged-particle detector array that is targeted primarily towards reaction studies with radioactive ion beams at FSU and the NSCL. ANASEN consists of 40 double-sided silicon-strip detectors backed with CsI scintillators and an innovative gas counter design that allows operation in a gas target/detector mode and experiments covering a broad range of center-of-mass energies simultaneously. Electronics based on ASIC components are being implemented to achieve a high channel count at low cost. Prototypes of all the detector components have been fabricated and are currently being tested. Performance of the individual components and plans for the first experiments that aim to improve our knowledge of the nuclear reactions important in stellar explosions will be reported.

1This work is supported by the National Science Foundation and U.S. Dept. of Energy.

11:09AM CD.00003 Use of Hulthen potential in Light-Front Two-Body Bound-state problem, YUKIHIRO TOKUNAGA, North Carolina State University — Solving the relativistic bound-state problem is an important task in nuclear physics. Even the two-body bound-state problem has been solved only under a certain approximation due to the nonperturbative nature. The two-body Bethe-Salpeter equation in the Wick-Cutkosky model was often solved in the ladder approximation without including the cross-ladder contribution, although many different and more accurate treatments of the numerical method to solve the bound-state problem have been developed nowadays. In this presentation, we use the exact solution to Hulthen potential as a trial wave function to solve the two-body bound-state problem based on the variational principle. We extend the light-front ladder approximation to include the cross-ladder contribution and present the numerical result of the binding energy versus the coupling constant including the particle and antiparticle effect to the cross-ladder coupling. In particular, we discuss the case with the exchange particle of non-zero mass to compare the effect in the Coulomb potential vs. the Yukawa potential. We show the effectiveness of our new trial wave function in variational method based on the Hulthen potential and further explain the individual contribution from the cross-ladder and the stretched-box.

11:21AM CD.00004 High Energy Pion Photoproduction from Nucleons in the Giessen Boltzmann-Uehling-Uhlenbeck Model, J. PRAJWAL MOHANMURTHY, Mississippi State University — For long, the transitions between perturbative and nonperturbative regimes of QCD have been of interest in nuclear physics. One of the methods used to study these transitions is to look for the onset of predictive QCD laws such as the quark counting rule. Measuring the differential cross section of certain exclusive reactions (such as pion photoproduction) has been one of the prime methods of investigating quark counting rules. The CEBAF Large Acceptance Spectrometer (CLAS) in Hall B at the Jefferson Lab (JLAB) has been used to measure the cross sections of pion photoproduction reactions. These measurements can be used to better understand the scaling laws. Although the cross-section does show scaling behavior, the onset of scaling is at unusually low energies and an unexplained sharp drop in the cross-section is observed just before the onset of scaling. There is a lack of theoretical calculations of pion photoproduction cross-section at these energies. The model known as the Giessen Boltzmann-Uehling-Uhlenbeck (gBUU) model has been used to calculate the pion photo-production cross-section and it was compared with the CLAS measurements. The preliminary results shall be presented.

11:33AM CD.00005 Relativistic Studies of the Charmionium and Bottomionium Meson Systems Using the Sucher Equation, CHARLES WERNETH, The University of Tennessee, KHIN MAUNG MAUNG, The University of Southern Mississippi — The bound states of quarks and anti-quarks (mesons) are studied with a relativistic equation known as the Sucher equation. Prior to this research, meson mass spectra had not been studied with the Sucher equation. Moreover, a full angular momentum analysis of the Sucher equation had not been investigated. The Sucher equation is equivalent to the Schrödinger equation with relativistic kinematics and a spin-dependent effective potential. Through a complete general angular momentum analysis, we find that angular momenta can couple through the effective potential without explicitly including the tensor component and antiparticle effect to the cross-ladder contribution. In particular, we discuss the way to couple through the effective potential without explicitly including the tensor component. We extend the light-front ladder approximation to include the cross-ladder contribution and present the numerical result of the binding energy versus the coupling constant including the particle and antiparticle effect to the cross-ladder coupling. In particular, we discuss the case with the exchange particle of non-zero mass to compare the effect in the Coulomb potential vs. the Yukawa potential. We show the effectiveness of our new trial wave function in variational method based on the Hulthen potential and further explain the individual contribution from the cross-ladder and the stretched-box.

11:45AM CD.00006 Exploring the Use of the Alabama Supercomputing Authority resources to supplement CMS Monte Carlo Production, CHARLES JENKINS, University of South Alabama, CMS COLLABORATION — The 14 TeV center of mass proton-proton collisions of the LHC is designed to search for the Higgs, but opens the possibility for observing new Physics. Currently, a faculty member at the University of South Alabama is studying the possibility of utilizing one of the 14 TeV center of mass proton-proton collisions of the LHC is designed to search for the Higgs, but opens the possibility for observing new Physics.

1Partially supported by DoE Grant DE-FG02-96ER40970 and possible in part by a grant of high performance computing resources and technical support from the Alabama Supercomputing Authority.
11:57AM CD.00007 Towards generic resolution of strong singularities in loop quantum cosmology, PARAMPREET SINGH, Louisiana State University — Singularities are the boundaries of classical spacetime in General Relativity. It has been always hoped that quantum gravitational effects may resolve these singularities. In this talk we will give an update on the recent status of the generic resolution of strong spacelike singularities in loop quantum cosmology. We will show that for flat and curved Roberston-Walker backgrounds and also for Bianchi-I models, loop quantum gravity effects resolve all strong curvature singularities. However, weak curvature singularities, that is those beyond which geodesics can be continued, may not be resolved.

12:09PM CD.00008 Characterization of pixilated Cadmium-Zinc-Telluride (CZT) Detector Sensitivity for Future Neutrinoless Double Beta (0νββ) Decay Searches, KEVIN MACON, ALEXANDER LEDER, JUN MIYAMOTO, THOMAS KUTTER, Louisiana State University — The detection of 0νββ decay provides an opportunity to determine whether neutrinos are Majorana or Dirac particles. Detecting 0νββ decay requires very sensitive detectors with good energy resolution. Pixelization in CZT detectors promises to improve sensitivity by means of improving background rejection. Our studies focused on the response of a pixilated prototype CZT detector to evaluate improvements in sensitivity. We performed energy resolution measurements for a 16 pixel CZT detector in the 100 keV to 1.3 MeV range. Common background sources were simulated and the measured energy resolutions were then incorporated to estimate detector sensitivities for a potential 0νββ Cd-116 decay signal. In this talk we present the status of our research, preliminary results and offer an outlook on future work and challenges.

12:21PM CD.00009 Studies of Bulk Properties of CZT and CMT Crystals for X-Ray and Gamma-Ray Detection at Ambient Temperature1, S.U. EGARIEVVE, A.E. BOLOTNIKOV, U.N. ROY, S.O. BABALOLA, A. KASSU, J. JOW, G. CAMARDA, P. FOCHUK, W. CHAN, K.H. KIM, J. STEIN, R.B. JAMES, A. BURGER, Alabama A&M University — Cadmium Zinc Telluride (CZT) and Cadmium Manganese Telluride (CMT) crystals have emerged as promising advanced materials for X-ray and gamma-ray detection at ambient temperature. An understanding of the bulk properties in relation to energy resolution and device performance has led to the development of CZT into commercial devices, and is contributing to the improvement of CMT. The key detector attributes are large band-gap energy (∼6 eV), tunable by Zn or Mn concentration), high atomic number, and high density (∼6 g/cm³). The techniques used in this study include infrared transmission microscopy, synchrotron X-ray diffraction topography, micro-scale X-ray mapping, and Pockels effect. We found that point defects and Te inclusions in CZT and CMT can trap the charge carriers generated by the absorption of X-rays, gamma-rays, and charged particles. We propose the use of thermal annealing and doping techniques to eliminate the deleterious effects caused by Te inclusions.

1Supported by DOE Brookhaven Lab, NNSA Massie Chairs grant; U.S. Nuclear Regulatory Commission grants, and ICx Radiation.

4:30PM - 4:30PM – Session DA Poster Session (16:30-18:00) Second Floor, Nicholson Hall

DA.00001 Synthesis and Field Skin Depth Studies on Tin Doped CeIn32, KRISTEN COLLAR, Florida State University, JASON COOLEY, Los Alamos National Lab, STAN TOZER, FSU-National High Magnetic Field Laboratory — CeIn3 is a cubic antiferromagnetic heavy fermion metal that orders with a Néel temperature of 10.1K at zero magnetic field. It requires fields up to 64T in order to see the Néel transition, however, low doping of tin has been shown to greatly reduce the Néel temperature into more accessible fields. The partial replacement of trivalent indium by tetravalent tin increases the number of conduction electrons and the nearly spherical Fermi surface occupies a larger fraction of the Brillouin zone. Small dopings will be critical in order to make the Néel transition more accessible given the magnets available at the National High Magnetic Field Laboratory (NHFML). The crystals will be characterized by calculating the Residual Resistance Ratios (RRR) using the resistivity option on the Physical Property Measurement System (PPMS) to determine the quality of the crystals. Skin depth measurements of the samples will be conducted by employing a Tunnel Diode Oscillator (TDO). The oscillations observed using the TDO will yield information about the Fermi surface and hopefully reveal information about the anomaly transition observed in the H-P phase diagram of CeIn3 at t ~400mK.

2NNSA, DOE Grant DE-FG52-10NA29659 and NSF DMR 0654118.

DA.00002 Study of Effects of Scratch and Shadow Defects on Superconducting Niobium Thin films1, DAVID MYERS, PHILLIP BROUSSARD, Covenant College — Using niobium thin films approximately 47 nm thick made by magnetron sputtering, we attempted to produce a superconducting sample exhibiting Josephson junction behavior. We began by studying resistance vs. temperature plots of unpatterned niobium thin film samples without defects in order to characterize the films that our deposition techniques were producing. We then studied patterned samples that consisted of narrow bridges between 200 μm and 400 μm wide and between 3 mm and 5 mm long. We measured resistance vs. temperature and voltage vs. current traces on patterned samples both with and without defects and with and without an applied magnetic field. The defects were produced on some samples by lightly scratching the Si substrates before deposition, and on other samples by using a thin wire to shadow the substrate during deposition. We were able to produce multiple scratched samples that had voltage vs. current traces characterized by a voltage jump, and one sample that exhibited clear hysteresis below a reduced temperature (t=T/Tc) of 0.9.

1Supported by NSF grant DMR-0820025.

DA.00003 Electronic Transport Properties of Pd-substituted (Zr,Hf)NiSn Half Heusler Alloys, WESTLY NOLTING, RUMANA YAQUB, SANSHRUT SAPKOTA, KEVIN STOKES, University of New Orleans — ZrNiSn-based alloys which crystallize in the half-Heusler structure are currently being investigated as potential thermoelectric materials due to their relatively large Seebeck coefficient. Here, we present measurements of the electronic transport properties of Zr0.5Hf0.5Ni1xPdxSn0.98Sb0.02 semiconducting half-Heusler compounds with Pd concentrations range from x=0 to1. The compounds are synthesized by solid-state chemical reaction at 900℃. The compounds are densified into 10 mm pellets by uniaxial hot pressing. Measured electrical conductivity, thermoelectric power, and Hall coefficient data are analyzed to extract carrier concentration and carrier mobility. All compounds in the series are n-type. The magnitude of the Seebeck coefficient is found to decreases with increasing Pd concentration. The electrical conductivity and carrier mobility are found to be dependent on the materials processing conditions as well as the Pd concentration.
DA.00004 Effects of the interior static polarization in photoionization of “regular” (A@C_{60}) and “giant” (A@C_{240}) endohedral atoms: A comparative study¹. TAKEHIRO AKIYAMA², VALERY DOLMATOV, University of North Alabama — Recently, photoionization of an atom A confined inside the C_{60} fullerene (A@C_{60}) has come under a novel theoretical scrutiny by accounting for static relaxation of the system in response to ionization of the atom A, termed the interior static polarization effect [1]. In the present work, we explore how the impact might get altered with increasing size of the fullerene cage. “Regular” C_{60} and “giant” C_{240} cages with the Ne atom sitting at the center of a cage, i.e., Ne@C_{60} and Ne@C_{240}, are chosen for the study. Both carbon cages are regarded as conducting spheres. They are simulated by the corresponding potentials of given inner radii, depths, and thickness [2]. The impact’s significance is found to be about the same in both systems. It strongly alters the photoionization of the encaged atom near threshold as well as changes phases of associated confinement resonances. However, the photoionization spectrum of the encaged atom differs much stronger from that of the free atom with increasing size of the cage. [1] V. K. Dolmatov and S. T. Manson, Phys. Rev. A (in print). [2] V. K. Dolmatov, Adv. Quant. Chem., 58, 13 (2009).

¹Supported by the NSF Grant No. PHY-0969386
²Undergraduate student

DA.00005 Molecular dynamics simulations on mid-linked polymer matrix. ADAM DILLON, HYE-YOUNG KIM, Department of Chemistry and Physics, Southeastern Louisiana University, DEVESH MISRA, Department of Chemical Engineering, University of Louisiana at Lafayette — We utilize molecular dynamics simulations to probe the dependence of thermodynamic properties on the structure of polymer molecules. We study four different polymer materials: (1) Long chain polymers of ~50 united atoms, (2) short chain polymers of ~10 united atoms, (3) mixture of long and short chain polymers with varied mixing ratio, and (4) polymer matrix of Long chains cross-linked by short chains. Here the cross-linking sites are not at the end of the chain (end-linked) of which most previous studies were done, but in the middle of the chain (mid-linked). We will discuss the difference in thermodynamic properties, such as glass transition temperature, among these four structures.

DA.00006 Patterned Polymer-Metal Ion Complexes, JONATHAN HOFFPAUIR¹, NAGA KORIVI, PRATUL AJMERA, Department of Electrical & Computer Engineering, Louisiana State University, Baton Rouge, LA 70803 — The doping of polymers with metal ions has been of interest due to the possibility of tailoring their electrical, optical and mechanical properties. Such tailored polymers have potential applications in a variety of areas including flexible electronic devices and systems, optical systems such as those for holography, data storage, and mechanical systems. To extend the applications of metal doped polymers to novel micro-devices and systems, it is pertinent to develop methodologies to pattern or structure such polymers in small dimensions, often in the micro-scale. We report on the development of micro-patterned thin films of polyvinyl alcohol (PVA) doped with copper (Cu^{2+}) ions. The films were patterned in the micro-scale dimensions and larger by contact printing onto a substrate. Patterned Cu^{2+} doped PVA films were also made by combining solution casting with micro-molding. Raman spectroscopic analysis of the developed Cu^{2+} doped PVA films revealed the presence of PVA-Cu^{2+} complexes. Further characterization of the Cu^{2+} doped PVA films for electrical conductivity and x-ray diffraction is in progress and will be presented. The doping of PVA by other metal ions is also being explored and initial results will be presented.

¹Undergraduate student

DA.00007 ABSTRACT WITHDRAWN —

DA.00008 Magnetic bead microrheology in Drosophila embryos¹. MARRIA C. ANGARITA — In this project, we developed the materials and methods that will be used to investigate the germ band retraction and dorsal closure stages of development in fruit fly embryos (about seven to eleven hours after fertilization) using the microinjection of superparamagnetic beads. As a first step, we calibrate the electromagnet by tracking bead displacement with the magnetic field on and off and use the bead velocity to estimate the magnetic force applied to the beads. This gives us an approximation of the magnetic field gradient around the pole tip, which will contribute to the in vivo calculations of the magnetic force exerted on the beads. We can thus extract the viscoelastic properties of the embryonic tissues during different stages of development by using Stokes’ Law.

¹2010 Vanderbilt University REU Program; National Science Foundation

DA.00009 Characterization of a Grazing-Incidence Dye laser. R. SETH SMITH, Francis Marion University — The grazing-incidence dye laser remains a versatile device for generating tunable laser radiation for a variety of scientific applications. A homebuilt grazing incidence dye laser was constructed at Francis Marion University. This laser is pumped by the second harmonic output from a Continuum Surelite I YAG laser. A small percentage of the pump radiation is coupled into the dye laser. A cylinder lens brings this light to a tight focus on the laser dye. The resulting fluorescence is dispersed by a diffraction grating that is held at grazing-incidence. A portion of this light is reflected by a tuning mirror and is directed back into the active medium for amplification. The output wavelength is controlled by scanning the tuning mirror. The performance of this dye laser was analyzed. The results will be presented and discussed.

DA.00010 Implementing the Landau-Pomeranchuk-Migdal (LPM) effect in a parton cascade. CHRISTOPHER COLEMAN-SMITH, Duke Physics — Recent data from the Relativistic Heavy-Ion Collider (RHIC) at Brookhaven have provided strong evidence for the existence of a transient Quark-Gluon-Plasma (QGP), where partons become freed from their non-perturbative confined states. Among these exciting findings is the suppression of particles with high transverse momentum (jet quenching). Parton Cascade Models (PCM) [1], which describe the full time-evolution of a system of quarks and gluons using pQCD interactions are ideally suited for the description of jet production, including the emission, evolution and energy-loss of the full parton shower in a hot and dense QCD medium. The Landau-Pomeranchuk-Migdal (LPM) effect, where quantum interference of parton wave functions due to repeated scatterings against the background medium, is likely the dominant mechanism for jet suppression. We have developed a probabilistic implementation within the PCM which can be validated against previously derived analytical calculations (BDMPS [2]), producing the expected length dependance of the lead parton energy loss.

¹Geiser K and Muller B, Nucl Phys B369 (1992)

DA.00011 N-16 Capture to Differentiate Between Neutrinos and Antineutrinos in SK. ASHLEY JONES, Duke University, SUPER KAMIOKANDE COLLABORATION — Super-Kamiokande is a large water Cherenkov neutrino detector in Japan. Without a magnetic field, the difference between neutrinos and antineutrinos is not apparent. But when negative muons capture on oxygen nuclei, oxygen-16 becomes nitrogen-16, which beta decays. Looking for this beta decay after low energy events within detector samples can signify neutrino events.
**DA.00012** Water Cherenkov Simulation Tuning and Comparison

Farzan Beroz, Duke University — This study compared SKdetsim and WCSim, two Monte Carlo simulations of Water Cherenkov detectors used mainly to investigate neutrino oscillation physics. SKdetsim is used for the Super-Kamiokande experiment while WCSim is for the Long Baseline Neutrino Experiment. Using the well-accepted SKdetsim as a standard, parameters of WCSim were adjusted to obtain a stronger agreement between the output of the two programs. Simulations of particles at high and low energies were then examined and compared to further understand the behavior of WCSim at extreme conditions. Although the outputs of the simulations were found to agree closely, additional parameters must be considered to allow for a finer tune.

**DA.00013** Analysis of the CDHSW Neutrino Oscillation Experiment

Jocelyn Mandalou, Florida State University — Analysis of the world’s neutrino oscillation data in terms of a phenomenology that employs the three known neutrinos allows extraction of the five parameters that determine the model. Three mixing angles and two mass-squared differences. However, two existing experiments, LSND and MiniBooNE do not fit within this model. These experiments lead to the suggestion that the addition of a fourth neutrino, called a sterile neutrino, might accommodate them. Two publications which use various approximations say that this suggestion does not work. The group with which I worked will do a full four neutrino analysis to further investigate this hypothesis. An additional experiment, CERN Dortmund Heidelberg Saclay Warsaw (CDHSW) was launched this investigation in the region of a large mass-squared difference, the region where a fourth neutrino is expected to lie. I constructed a computational tool that analyzes the CDHSW experiment by calculating the probability for mu neutrinos to not oscillate in the CDHSW experiment. It was calibrated to reproduce the two-neutrino results given by the experimentalists and then will be generalized to four neutrinos. It will be used in the larger analysis which will include all of the world’s data.

**DA.00014** Prospects for a Low Threshold Neutrino Experiment at the SNS

Taritree Wongjirad, Duke University — A low-threshold neutrino scattering experiment at a high intensity stopped-pion neutrino source has the potential to measure coherent neutral current neutrino-nucleus elastic scattering. A promising prospect for the measurement of this process is a noble-liquid-based experiment at the Spallation Neutron Source: an example is the proposed CLEAR (Coherent Low Energy Nuclear Recoils) experiment. This poster will present the design of this experiment and its physics reach.

**DA.00015** Monte Carlo Simulations for Future Geoneutrino Detectors

Morgan Askins, Florida State University — The main contribution of heat in the earth’s mantle is thought to be the radioactive decays of 238U, 232Th, and 40K. A precise measurement of the levels of 238U and 232Th can be determined by measuring the flux of electron anti-neutrinos (geoneutrinos) emitted from their decay chains. Although detectors such as KamLAND and Borexino have detected few geoneutrinos, a new cost effective geoneutrino detector is proposed which takes advantage of the total internal reflection within a long rectangular prism acrylic container of liquid scintillator having a single photomultiplier tube (PMT) on each end. An array of these containers would allow for a large scintillator volume relative to the number of PMTs, but could have a lower radio-purity. The event signatures of these decays were compared to those from neutrino interactions using Monte Carlo simulation software based upon GEANT4. In this poster I will discuss the limitations which arise from this design such as, the thickness of the acrylic container which causes high loss of optical photons due to scattering and absorption, rod length which results in higher scattering rates within the scintillator, and size of the array.

**DA.00016** Investigations of Data Quality in LIGO Data, Techniques

Brooke Rankins, University of Mississippi — The existing data quality (DQ) flag veto pipeline procedure used to categorize DQ flag channels and calculate their associated metric attributes relies heavily on MATLAB scripts. The scripts have been built upon each other ad-hoc as users have required new information, sometimes with limited documentation. We are restructuring the calculation process in an object-oriented language, Python, for two primary purposes. The first is to allow users to retrieve specific isolated information without having to run the entire pipeline. The second is to calculate additional summary statistics regarding DQ flag interaction, which may prove useful in evaluating the effectiveness of the categorization process. The nature of the Python vetopipeline code allows the addition of such new features with greater simplicity. The presentation will detail the framework of the Python vetopipeline, and introduce the DQ flag interaction statistics.

**DA.00017** Parallel Phase Modulation for Advanced LIGO

Michael T. Hartman, Benjamin Wu, University of Florida, Volker Quetschke, University of Texas at Brownsville, Muzammil Arain, David Reitze, David Tanner, Guido Mueller, University of Florida — LIGO is a ground based interferometer gravitational wave observatory which attempts to detect gravitational waves by measuring the length changes between its two arms. To operate the interferometer it is necessary to control several longitudinal and angular degrees of freedom of the interferometer. These signals are formed by phase modulation and demodulation of the laser field. Phase modulation introduces frequency sidebands to the carrier laser beam; LIGO requires multiple sidebands to disentangle all the longitudinal and angular signals. The modulation is usually applied by a series of modulators which also generate sidebands around sidebands. Current length and alignment sensing schemes don’t require parallel phase modulation, however, if there needed to be a change in the sensing schemes, sidebands of sidebands could limit the performance of LIGO. This talk covers the results of an experiment whose goal is to avoid sidebands of sidebands by modulating the laser in parallel within two arms of a Mach-Zehnder interferometer. In this system, the Mach-Zehnder’s arm lengths must be stabilized to meet Advanced LIGO requirements. I will report on the status of this risk reduction activity.

1 This work is supported by NSF grant 0653582.

**DA.00018** Quantum Evolution of Scalar Fields in Spherically Symmetric Gravity

Brajesh Gupt, Jorge Pullin, Louisana State University, Baton Rouge, LA 70803 — We present progress of our first step towards theoretical and numerical study of the quantum evolution of massless scalar field in gravity. We utilise the framework of loop quantum gravity and calculate the Classical Hamilton’s equation of motion for scalar field $\phi$ and gravitational variables (connection variable $K_\alpha$ and triads $E^\alpha$). Equations are then quantised through LQG approach. The scalar field evolves as a spherically wave-like function as expected. Theoretical results are presented and its importance in study of quantum collapse is discussed.

**DA.00019** Varying-G Cosmology with Type Ia Supernovae

Rutger Dungan, Harrison Prosper, Florida State University — The observation that Type Ia supernovae (SNe Ia) are fainter than expected given their red shifts has led to the conclusion that the expansion of the universe is accelerating. The widely accepted hypothesis is that this acceleration is caused by a cosmological constant or, more generally, some dark energy field that pervades the universe. This hypothesis presents a challenge to physics so severe that one is motivated to explore alternative explanations. We explore whether the data from Type Ia supernovae can be explained with an idea that is almost as old as that of the cosmological constant, namely, that the strength of gravity varies on a cosmic timescale.

**DA.00020** LBNE Supernova Study: Distance Sensitivity for An Early Supernova Alert

Wes Johnson, Duke University — The aim of this study is to compare the distance sensitivity to supernova burst events of various possible neutrino detector masses. We examine distance sensitivity at various background rates.

**DA.00021** ABSTRACT WITHDRAWN
DA.00022 Ideas on How to Improve the Inertial Navigation Systems, ARGENIS DA SILVA — Inertial navigation systems (INS) present some difficulties. For example, the drifting. Part of the problem is the integration. The readings of the system give the acceleration, this acceleration must be integrated over some time interval to get the velocity. And the velocity must be integrated to get the position. This double integration introduces much of the errors. Here we present an idea to get the position using only one integration and we show how to use the acceleration as a measure of the errors. The scheme make it possible to extend the autonomy and accuracy of the INS beyond the today values.

DA.00023 E = (f.d) + G, PETER SCHICK — Energy equals work plus gravity. In vacuum, work is attracted to gravity, which creates energy. Gravity and work are attracted to each other which create energy.

DA.00024 POST-DEADLINE POSTERS —

DA.00025 Entanglement-enhanced BB-84 Scheme for Quantum Key Distribution, CARL SABOTTKE, BHASKAR ROY BARDHAN, CHRIS RICHARDSON — We develop a novel enhancement to the traditional BB-84 scheme for quantum key distribution using entanglement. To improve the security of the scheme and its resilience to the photon number splitting attack. The potential benefits and shortcomings of this scheme are then compared to the popular decoy states solution to the photon number splitting attack.

DA.00026 The mass, energy, space and time systemic theory-MEST change the orbit of earth and dark comet to avoid their impaction each other, DAYONG CAO, Beijing Natural Providence Science & Technology Development Co., Ltd — Things have their own system of mass, energy, space and time of themself. (The MEST for short there in after). The time is from the frequency of wave, the spac is from the amplitude square of wave. There is the transmutation (and interaction) between the space-time and mass-energy. There is the balance system between the space-time and mass-energy. Sun and its companion dark hole make up of MEST. Because there is the “transmutation” and the “balance system” between sun and its companion dark hole. So the “pseudo” dark mass-energy go into sun, control and ignite its nuclear fission-fusion (of sun of mass-energy); the “pseudo” light go into the dark hole, control and ignite its nuclear fission-fusion (of dark hole of space-time). The dark mass-energy make up of the negative proton and the negative neutron. And the dark atom of the dark comet make up of the dark photon, the dark neutrino and the dark muon. The companion dark hole will go near sun and take the dark comet to impact our earth. We need study their “transmutation” and their “balance system,” and need find a new energy both of the nuclear fission-fusion of sun and the “nuclear fission-fusion” of dark hole. We will use them to change the orbit of earth and dark comet, and will avoid the dark comet to impact our earth-a astronomic orbital engineering. Not only we need change the mass-energy to the space-time, but also we need change the space-time to the mass-energy.

DA.00027 Nondestructive analysis of Telescope Surfaces and Coatings, JULIE SCOTT, EDWARD KINTZEL, LOUIS STROLGER, SCHUYLER WOLFF, Western Kentucky University — The Department of Physics and Astronomy at Western Kentucky University has a Large Chamber Scanning Electron Microscope (LCSEM) available for materials analysis. As one of 10 in the world, the capability exists for nondestructive analysis of large samples. Currently we are investigating using the LCSEM to quantify reflectivity and long-term integrity for large segments of optical elements and detectors for ground and space-based environments. Comparisons of reflectance ratios as a function of surface roughness for Al-Coated optical mirrors may be confirmed with the LCSEM. Long-term structural integrity of Al-coated thinned mirror segments at ground-based facilities due to weather (oxidation) and spaced-based high-radiation environments can be investigated. Fatigue behavior of these metallic films from active/adaptive actuation will be simulated using the LCSEM. New research possibilities across a broad multidisciplinary spectrum will be key to the success of the LCSEM facility. These partnerships will lead to the development of new and existing technologies.

DA.00028 Development of a Portable Automated Gas Environment System (PAGES2), JACOB BAXLEY, NATHAN CAMPBELL, EDWARD KINTZEL, Western Kentucky University, BRUCE HILL, LOUIS SANTODONATO, KENNETH HERWIG, Spallation Neutron Source — For the user community at the Spallation Neutron Source (SNS), a portable automated gas environment system (PAGES2), capable of remote operation at pressures up to 100 bar has been built and programmed. The function of this system will be to characterize a variety of high surface area materials and allow studies of energy significant gases such as methane on these surfaces to be carried out. Understanding the fundamental physics of interaction at the gas-surface interface is key for the generation of application-minded products such as fuel cells. PAGES2 can generate adsorption isotherms to determine surface area of the material as well as the number of gas molecules required for a specific surface coverage. This system will not only produce new science, but also allow for better experimental design. PAGES2 system testing is currently underway, and initial results indicate the system is operating as designed. Future tests will be done prior to use at the SNS.

DA.00029 High Performance Quantum Cascade Lasers¹, MATTHEW ESCARRA, PETER LIU, YU YAO, RICHARD CENDEJAS, LOAN LE, CLAIRE GMACHL, Princeton University, MIRTHE NSF-ERC TEAM — Quantum cascade (QC) lasers have shown great promise for use in applications ranging from trace chemical detection to infrared countermeasures. Since light is generated through intersubband transitions in coupled quantum wells, as opposed to interband transitions that are restricted by available materials, QC lasers have an enormous amount of flexibility in their design space. This flexibility allows for lasing across the mid-infrared and even in the terahertz portions of the spectrum. We report on our recent work to improve the performance of these devices, by discussing the results of low voltage defect, strong coupling, and broad gain approaches to QC laser design. One of these laser designs will be put into context through discussion of our latest work to use QC lasers for detecting CO2 isotopic concentrations in the atmosphere.

¹This work is supported in part by MIRTHE (NSF-ERC) and DARPA-EMIL.

DA.00030 Investigation of multiplexed plasmonic structure metamaterials with equivalent transmission line model, BOYANG ZHANG, JUNPENG GUO, Department of Electrical and Computer Engineering, University of Alabama in Huntsville, Huntsville, AL 35899, STUART YIN, Department of Electrical and Computer Engineering, Pennsylvania State University, University Park, PA — We report our investigation of multiplexed structure metamaterials with the equivalent coupled transmission line model. In this metamaterials, two plasmon resonance elements are multiplexed in each unit cell of the periodic structures. Symmetrically multiplexed structures give increased spectral bandwidth and the non-symmetrically multiplexed structures give the band splitting property. By varying the gap size between the multiplexed elements, we find the plasmonic coupling affects the spectral property of the multiplexed structure metamaterials. We have developed a coupled transmission line model that can successfully model the multiplexed structure metamaterials when far-field coupling dominates, but the coupled transmission line model cannot describe the multiplexed plasmonic structures when the strong near-field coupling occurs.
DA.00031 Nonlinear Cosmological Predictability Time\(^1\), KEITH ANDREW, JOHN WILSON, Western Kentucky University — We examine time scales for phase space orbits in a FRW cosmological model coupled to a scalar field. The cosmological model from the Einstein field equations are coupled to the Klein-Gordon equation for a spin zero scalar field with an interaction potential \(V(\phi)\). The resulting cosmological equations are nonlinear in the scale cosmic parameter and scalar field. The equations can be linearized in the neighborhood of equilibrium points and then diagonalized to yield a classification of solutions. Some of the solutions exhibit a sensitive dependence on initial conditions and an exponential deviation or orbits in phase space. Such deviations can be characterized by a predictability time beyond which all information about the initial state of the system is lost. We calculate the predictability time in terms of the scalar field potential function for this system and compare it to the cosmic spacetime big rip time scale for a scalar field source term.

\(^1\)We wish to acknowledge support from NASA/KSGC.

Thursday, October 21, 2010 5:00PM - 6:00PM –
Session DB Employment and Summer Research Opportunities for Graduate and Undergraduate Students Nicholson Hall 109

5:00PM DB.00001 Research, Applications and Employment Opportunities in Earth System Science, FRANCO EINAUDI, NASA — I will describe the scientific challenges facing Earth System Science and its many applications both in the area of weather forecasting and climate. I will also touch upon the responsibilities that people in our area have in communicating their results with the public at large as well as with policy makers. This informal presentation will be of interest to graduate and undergraduate students interested in potential research experiences or employment in atmospheric, ocean and Earth physics.

5:30PM DB.00002 International REU for Gravitation\(^1\), GUIDO MUELLER, University of Florida — The National Science Foundations (NSF) funds many Research Experience for Undergraduate Students (REU) Programs at many Universities in the US. The NSF also funds a small number of REU programs which allow students to conduct their summer research abroad. One of these programs is the International REU for Gravitation which is organized out of the University of Florida. This program sends students to partner institutions in Australia, France, Germany, the Netherlands, Italy, Japan, and the United Kingdom. I will describe the program, how to apply, the schedule, and the feedback we received from the students and will answer all other questions regarding the IREU. Additional information is available at http://www.phys.ufl.edu/ireu

\(^1\)This program is supported by the NSF grant PHY1005036.

Thursday, October 21, 2010 7:00PM - 7:30PM –
Session EA Physicists and Congress: Entropy of Mixing Nicholson Hall 130

7:00PM EA.00001 DC State of Mind: A Congressional update, KRISTOPHER LARSEN, American Physical Society — Every day the headlines are dominated by news of a slow economic recovery, high unemployment, and a Congress focused on the next election. Deficit hawks, Tea Partiers, partisanship, and mid-term elections are all topics typically outside the ken of physics but are critically important to our ability to continue to pursue cutting edge innovative research. For example, during the last six months Congress has, among other things, worked on passing the 2011 federal budget and reauthorization of America COMPETES. Both of these major pieces of legislation are fundamental to how our country will fund physics research for the next few years. For the past two years, science has done very well thanks to the support of Congress and the administration. The coming years are going to be far more difficult and every physicist needs to commit themselves to defending the gains we have made. This talk will provide an overview of what has happened on Capitol Hill in the past few months and what, to the best of our knowledge, the physics community can expect for the coming years. Also included will be a discussion of how physicists can get involved, educate Congress, and assure that the United States retains a strong commitment to basic research.

Friday, October 22, 2010 8:30AM - 10:30AM –
Session FA Pygmies, Superheavies, and Magic: The Exotica of Nuclear Structure Nicholson Hall 119

8:30AM FA.00001 Nuclear many-body problem, from reactions to structure\(^1\), ALEXANDER VOLYA, Florida State University — Structure and reaction aspects, while usually discussed separately, are deeply entangled in the nuclear many-body systems. In this presentation we highlight the advances, as well as difficulties in the path toward building a unified approach. For model studies of reactions involving composite objects, we obtain exact solutions with the newly developed Variable Phase Method. We demonstrate some non-trivial aspects of the dynamics projected unto the intrinsic Shell Model space. We discuss the limitations of the projection methods as well as convergence properties of the solutions. We present the Time Dependent Continuum Shell Model (TDCSM) and demonstrate its application to realistic nuclear problem. In the case of \(^8\)B the observation of the \(^7\)Be(p,p') cross section, its angular dependence, and interference between resonances allows one to make in-depth conclusions about the many-body structure using TDCSM. We find that virtual excitations are important. Behavior of the spectroscopic amplitudes, and changes in the collective dynamics due to the presence of reaction continuum will be discussed.

\(^1\)This work is supported by the U. S. Department of Energy grant DE-FG02-92ER40750.
9:00AM FA.00002 Synthesis of a new element with Z=117†. JOSEPH HAMILTON, Vanderbilt University — The synthesis of new elements with neutron number (N) approaching 184 provide important tests of nuclear structure models used to predict closed spherical shells in the heaviest elements. Earlier, elements with Z=113-116, and 118 were synthesized in reactions of 48Ca with actinide targets at JINR. The synthesis of previously unknown Z=117 can provide additional crucial tests of the shell structure near the predicted Island of Stability with N=184. Here we report the synthesis of 293,294117 (N=176,177) in the 48Ca + 249Bk 4n and 3n reactions. The 249Bk was produced at ORNL in the High Flux Isotope Reactor and chemically separated at the Radiochemical Engineering Development Center at ORNL. Six arc-shaped targets of 0.31 mg/cm2 of 249Bk were made at the Research Institute of Atomic Reactors (Dimitrovgrad). The experiments were performed employing the Dubna Gas-Filled Recoil Separator and the heavy-ion cyclotron U-400 at JINR, Russia. Separated evaporation residues were registered by a time-of-flight system and implanted in a 4 cm x 12 cm Si-detector array with 12 vertical position-sensitive strips surrounded by eight 4 cm x 4 cm side detectors. Irradiation at 252 MeV for 70 days starting July 27, with a total beam dose of 2.4 x 1019 yielded five position-correlated (≤1.2 mm) decay chains of 3 α’s followed by spontaneous fission. These were assigned to 293,294117 produced in the 4n reaction. At a 48Ca energy of 247 MeV a new decay chain was detected involving six consecutive α-decays and ending in 5f and assigned to 294117 (3n channel). The daughters of 293,294117 have one or two more neutrons than previously observed isotopes and have much longer half-lives. The decays of the eleven newly identified isotopes expand substantially our knowledge of odd-Z nuclei of the most neutron-rich isotopes of elements 105 to 117. These nuclei display increasing stability with increase in neutron number to strongly support the island of stability. Their longer half lives open up further studies of the chemistry of super-heavy elements and their place in the Periodic Table.

†For the Joint Institute for Nuclear Research, Oak Ridge National Lab, Vanderbilt U, Lawrence Livermore National Lab, Research Institute of Atomic Reactors, and U. Nevada LV collaboration.

9:30AM FA.00003 Single particle spectroscopy of 133Sn via the (d,p) reaction in inverse kinematics†, KATE JONES, University of Tennessee — It is important, both for nuclear structure physics and understanding the synthesis of heavy elements in the cosmos, to determine how single-particle states change as we move away from the valley of stability, especially around shell closures. One powerful method to probe single-particle structure of nuclei is to use single-nucleon transfer reactions. With short-lived exotic nuclei, these reactions need to be performed in inverse kinematics, using a radioactive ion beam and light ion targets. A beam of 132Sn produced at ORNLs Holifield Radioactive Ion Beam Facility was used in a transfer reaction experiment to study single-particle states in 133Sn. The beam impinged on a target of CD2 with effective thickness of around 150µg/cm2. Charged ejectiles were detected in an array of position sensitive silicon detectors, mostly of the new ORRUBA type, with SIDAR detectors at very backward angles. At forward laboratory angles, telescopes of detectors were used to discriminate protons from heavier, elastically scattered particles. From the angles and energies of the protons, the energies of the states populated in the final nuclei were measured. The present work has determined the purity of the low-spin single-neutron excitations in 133Sn. A previously unobserved state in 133Sn has also been measured here for the first time. The simplicity of the structure of 133Sn, and the single-neutron excitations in 133Sn, provides a new touchstone needed for extrapolations to nuclei further from stability, in particular those responsible for the synthesis of the heaviest elements via the r-process.

†This work was supported in part by the National Science Foundation, U.S. Department of Energy Office of Science and National Nuclear Security Administration. ORNL is a DOE laboratory operated under contract by UT-Battelle.

10:00AM FA.00004 Study of the Nuclear Electric and Magnetic Dipole Response using Monoenergetic and Polarized Photons†, ANTON TONCHEV, Duke University — In stable and weakly bound neutron-rich nuclei a resonance-like concentration of dipole strength is observed at excitation energies around the neutron separation energy. This clustering of strong dipole transitions has been named the pygmy dipole resonance (PDR) in comparison to the giant dipole resonance that dominates the E1 response. Microscopic nuclear models predict the existence of the PDR arising from an oscillation of a small portion of neutron-rich nuclear matter relative to the rest of the nucleus. In addition, the dipole strength distributions at the particle separation energies might affect the reaction rates in astrophysical scenarios where photo-disintegration reactions are important, i.e., in hot stars and stellar explosions. This talk is giving an overview of the high-sensitivity studies of E1 and M1 transitions in neutron closed-shell nuclei using the nearly monoenergetic and 100% linearly polarized photon beams from the High-Intensity-Gamma-Ray Source facility. The fine and gross structure of the dipole-strength distribution of the PDR has been observed for the first time and novel information about the character of this mode of excitation has been obtained. The observations will be compared with calculations using statistical and quasiparticle random-phase approximation.

†This work is partially supported by a grant from the Department of Energy DE-FG02-97ER41033.

Friday, October 22, 2010 8:30AM - 10:30AM – Session FB Optoelectronics and Advanced Materials Nicholson Hall 109

8:30AM FB.00001 Abs-initio, Predictive Calculations for Optoelectronic and Advanced Materials Research†, DIOLA BAGAYOKO, Southern University and A&M College in Baton Rouge (SUBR) — Most density functional theory (DFT) calculations find band gaps that are 30-50 percent smaller than the experimental ones. Some explanations of this serious underestimation by theory include self-interaction and the derivative discontinuity of the exchange correlation energy. Several approaches have been developed in the search for a solution to this problem. Most of them entail some modification of DFT potentials. The Green function and screened Coulomb approximation (GWA) is a non-DFT formalism that has led to some improvements. Despite these efforts, the underestimation problem has mostly persisted in the literature. Using the Rayleigh theorem, we describe a basis set and variational effect inherently associated with calculations that employ a linear combination of atomic orbitals (LCAO) in a formalism that has led to some improvements. We present the Bagayoko, Zhao, and Williams (BZW) method [Phys. Rev. B 60, 1563 (1999); PRB 74, 245214 (2006); and J. Appl. Phys. 103, 096101 (2008)] that systematically avoids this effect and leads (a) to DFT and LDA calculated band gaps of semiconductors in agreement with experiment and (b) theoretical predictions of band gaps that are confirmed by experiment. Unlike most calculations, BZW computations solve, self-consistently, a system of two coupled equations. DFT-BZW calculated effective masses and optical properties (dielectric functions) also agree with measurements. We illustrate ten years of success of the BZW method with its results for GaN, C, Si, 3C-SiC, 4H-SiC, ZnO, AlAs, Ge, ZnSe, w-InN, c-InN, InAs, CdS, AlN and nanostructures. We conclude with potential applications of the BZW method in optoelectronic and advanced materials research.

†My collaborators include Dr. G. L. Zhao, Dr. T. D. Williams, Ms. L. Franklin, Mr. A Pullen, Dr. H. Jin and Mr. C. E. Ekuma. Our work was funded in part by LONI, NSF, NASA, and Ebonyi State of Nigeria.
control surface plasmon-polaritons with nanolayers and nanostructures. JUNPENG GUO, University of Alabama in Huntsville — Surface plasmon nanophotonics is an emerging area which has manifested many potential applications for sensing, imaging, and communications. Surface plasmons are the free electron density oscillations on surfaces of metals. The free conduction electron density oscillations are always coupled with localized electromagnetic fields. An important property of surface plasmon-polaritons is the highly confined electromagnetic field near metal surfaces at the plasmon resonance. Although surface plasmons can confine electromagnetic energy in the nano-scale, a fundamental problem is the energy dissipation/loss in metal materials. In this talk, I will review recent progress in mitigating the loss of surface plasmon-polaritons and techniques for engineering surface plasmon-polaritons with hetero-dielectric nanolayers and nanostructures for various applications.

optical spectroscopy of plasmon-enhanced emissions and scatterings for advanced photonic devices. JAETAE SEO, Hampton University — Quantum electrodynamic coupling between excitons or phonons and plasmons has been of great interest for fundamental scientific research and photonic applications of lighting devices and bio-chemical sensing. Exciton-plasmon coupling of semiconductor quantum dots (SQDs) and metal nanoparticles (MNPs) provides high internal quantum efficiencies because of the localized surface plasmon resonance (LSPR) excitation and the faster coupling decay rates compare to the nonradiative decay rates. The enhancement and quenching of internal quantum efficiencies are determined by the coherent coupling condition and the balance between the faster resonant energy transfer from SQDs to MNPs than the nonresonative decay in SQDs and local field enhancement in the vicinity of MNPs. The resonant coupling of phonon-plasmon with analyte-linked MNPs also provides large enhancement of vibrational intensity in the analyte molecule because of strong LSPR and large polarizability of dimer-like MNP assemblies along the long-axis direction. Major physical origins of scattering enhancement could be the localized electromagnetic hot spots, the chemical energy transfer effects, and the spectral resonant excitation to the longitudinal plasmon modes. Acknowledgments: This work at Hampton University was supported by the National Science Foundation (HRD-0734635 and HRD-0630372).

10:00AM FB.00004 Studies of Microwave Absorption Properties of Carbon Nanotubes/Epoxy Composites. GUANG-LIN ZHAO, Southern University and A&M College — Less weight, excellent mechanical properties, and high efficiency in absorbing electromagnetic (EM) wave make carbon nanotubes (CNTs) composites attractive for microwave technology applications. Multi-walled carbon nanotubes (MWNTs) have much higher performance-to-price ratio (PPR) than SWNTs do in the composite applications. In this work, we aim to study the effect of the outside diameter (OD) distributions of MWNTs on their microwave absorption properties. We have fabricated six groups of carbon nanotube/epoxy composite samples with various OD distributions. The weight percentages of MWNTs in the composites were controlled in the range from 1 to 10%. We utilized a microwave resonant cavity technique to measure the microwave absorption properties of all the sixty samples around the central frequency of 9.968 GHz. Our results have shown that the maxima of EM wave absorptions for the six groups of samples were all around 7% MWNTs weight percentage. We further studied the effective attenuations of the electric and magnetic fields in six groups of MWNT composite samples with the same (7 %) MWNT blend in epoxy. The results show that, in general, the MWNTs with smaller diameters have higher microwave absorption at 9.968 GHz. However, sample group M5 (OD=8nm) shows unusual results, a lower microwave absorption than the other samples. We then used a scanning electron microscope (SEM) to study the morphologies of the MWNT samples. Based on the SEM analysis and microwave absorption measurements, we found that the efficiency of the microwave absorption of MWNT/Epoxy composites is strongly affected by the morphologies/structures of MWNTs in individual bundles.

Friday, October 22, 2010 8:30AM - 10:18AM — Session FC Explosions, Momentum, and Mathematical Physics

8:30AM FC.00001 Formulation of Macroscale Compaction Dynamics based on Mesoscale Simulations of Uniaxial Waves in Granular Explosive. SUNADA CHAKRAVARTHY, KEITH A. GONTHIER, Louisiana State University, Baton Rouge, LA 70803 — A macroscale continuum theory for Deflagration-to-Detonation Transition (DDT) in granular explosive is generalized to account for the simultaneous existence of an arbitrary number of condensed phases. The theory assumes phase separation, and allows for flexible partitioning of dissipation between phases in a thermodynamically consistent manner. The constitutive theory is complex and requires descriptions for dissipation partition functions, relaxation rate functions, and phase-specific parameters that are not well-characterized, particularly for dynamic loading. A key focus of this study is to formulate expressions for phase-specific intergranular stresses and compaction-potential energies based on mesoscale simulations of uniaxial compaction waves because of their importance to compaction induced heating and combustion. Predictions will be compared to quasi-static compaction data for granular HMX.

8:42AM FC.00002 Low-Order Modeling for the Impact Energetics of Laser-Driven Micro-Flyers with Thin Stationary Targets. MARK FRY, KEITH GONTHIER — The impact of high-speed (500-1500 m/s), laser driven micro-flyers (thickness ∼ 5 μm) with thin energetic targets (thickness ∼ 10 μm) is being examined to characterize deformation induced heating and combustion of these materials. To guide development of experiments, a low-order (zero-dimensional) model is formulated that can accurately and efficiently estimate ballistics maps for a large dimensional parameter space. The model accounts for the energetics of early time wave interactions and longer time shearing of the target during penetration and perforation. The model is validated against data for the impact of laser flyer and target configurations, and is used to predict ballistic maps for micro-scale configurations. Preliminary predictions for the impact of aluminum micro-flyers with thin steel targets indicate that the ballistic behavior is sensitive to micro-flyer mass and geometry. Model limitations are highlighted, and improvements are suggested.

This work was supported in part by the Defense Threat Reduction Agency, Basic Research Award # HDTRA1-10-1-0018, to Louisiana State University, and the Air Force Research Laboratory, AFRL/RWK, Research Award # FA8651-09-1-0021, Eglin AFB, Florida.
transmutation and the interaction between the dark hole system and star system. The general relativity equation,

\[ R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}R = -\kappa T^\mu_\nu, \]

shows that the cosmological model is a balance system. The star system and the dark hole system are the uniform distribution. There is the energy-mass structure; the right of the equation is the dark space-time (field) tensor. The left of the equation is the metric tensor of the space-time structure; the right of the equation is the dark space-time (field) tensor.

The results of a parametric study examining the effects of wave strength, initial solid volume fraction, and particle diameter on the wave profiles are examined, for both planar piston impact and spherical particle dispersion simulations. The relative contributions of compression, compaction and drag to the gas and solid energetics are analyzed to assess the likelihood of combustion initiation.

1 Supported by NSF-IGERT on CFD at LSU

9:06AM FC.00004 Design of a spin-down experiment for measuring momentum accommodation on planar surfaces, TATHAGATA ACHARYA, MICHAEL MARTIN, Department of Mechanical Engineering, Louisiana State University, Baton Rouge, USA — A mathematical model has been developed to quantify momentum accommodation coefficient as a function of ambient pressure, gas density, ambient temperature, mass of the gas molecule, and the angular velocity of a disk. An experimental method is proposed for the measurement of momentum accommodation coefficient. The experimental method involves accelerating a disk to a given angular velocity and then allowing it to spin down over a measured time interval. Numerical simulations have been performed to evaluate the correct size of experimental chamber in order to avoid wall effects, and to determine the limiting pressure that will help achieve free molecular flow in the experimental chamber. Simulations indicate that the transition between the continuum and free molecular regimes starts below \(10^{-4}\) atmospheric pressure.

9:18AM FC.00005 Frame Indifferent (Truly Covariant) Formulation of Electrodynamics, CHRISTO CHRISTOV, University of Louisiana at Lafayette — The Electromagnetic field is considered from the point of view of mechanics of continuum. It is shown that Maxwell’s equations are mathematically strict corollaries form the equation of motions of an elastic incompressible liquid. If the concept of frame-indifference (material invariance) is applied to the model of elastic liquid, then the partial time derivatives have to be replaced by the convective time derivative in the momentum equations, and by the Oldroyd upper-convected derivative in the constitutive relation. The convective/convected terms involve the velocity at a point of the field, and as a result, when deriving the Maxwell form of the equations, one arrives at equations which contain both the terms of Maxwell’s equation and the so-called laws of motional EMF: Faraday’s, Oersted–Ampere’s, and the Lorentz-force law. Thus a unification of the electromagnetism is achieved. Since the new model is frame indifferent, it is truly covariant in the sense that the governing system is invariant when changing to a coordinate frame that can accelerate or even deform in time.

9:30AM FC.00006 Linear and Nonlinear Effects in Freak Wave Formation, JESSICA GRABER, Xavier University — Freak (or rogue) waves are waves of great height that appear out of nowhere from otherwise ordinary, if rough, seas. The steepness of these waves can cause an enormous amount of damage to ships and oil platforms. The number of these waves physically occurring appears to be larger than predicted by the Gaussian statistics often used to model sea states. Understanding the cause of freak waves will help us to predict dangerous conditions, and engineer structures better able to withstand such waves. A number of mechanisms have been studied as the source of freak waves, including linear focusing, refraction of waves through a current field, and nonlinear effects. The Benjamin-Feir instability is a promising candidate with “breather” solutions of the nonlinear Schrödinger equation. Two of these breather solutions are the Ma soliton solution with large waves appear periodically in space at a given time, and the Akhmediev soliton solution, which is a wave forming periodically in time at a specific position. The relationship between linear and nonlinear effects has not been well-studied. Comparing the time scales on which the linear and nonlinear effects act gives us an idea of the regime in which various input parameters cause one effect or the other to be negligible, and when they act together to create a heightened response.

9:42AM FC.00007 Approximate Solutions to \(d^2x/dt^2 + [1+(dx/dt)^2]x = 0\) Using a Polar Representation, KALE OYEDEJI, Morehouse College, RONALD E. MICKENS — It can be shown that the following nonlinear differential equation

\[ d^2x/dt^2 + [1+(dx/dt)^2]x = 0 \]

has only periodic solutions. The application of standard perturbation methods, harmonic balance, and other approximation techniques all reach the conclusion that the angular frequency has a singularity for a finite value of the initial amplitude A, where the initial conditions are \(x(0) = A\) and \(dx(0)/dt = 0\). Since a phase-space analysis demonstrates that such a singularity does not exist, we make use of scattering methods to give the required valid behavior for the angular frequency as a function of the initial amplitude. This presentation reports our work using a method based on a polar representation for the periodic solutions. We compare these results with a priori calculations and give an explanation as to why the earlier calculations were “interpreted” as being incorrect.

9:54AM FC.00008 Polar Representations of Solutions to Nonlinear Oscillator Differential Equations, RONALD E. MICKENS, Clark Atlanta University — A fundamental issue in the theory of nonlinear oscillations is how to construct valid analytical approximations for the oscillatory solutions of the associated second-order differential equations. If such equations have a harmonic oscillator limiting form, then, in general, these equations may be reformulated such that a small parameter can be created and the standard perturbation methods can then be applied to determine approximations to the required solutions. Other “global” methods, e.g., harmonic balance, can also be used to obtain estimates for periodic solutions. Our purpose in this presentation is to construct a new technique which may then be used to calculate approximations to the oscillatory solutions of nonlinear oscillatory systems. This method begins with an exact polar mathematical representation for the solution. These equations are then converted to an iteration scheme which can be used to determine approximate solutions to the original problem. An advantage of this procedure is that all of the iterations may be solved (at least to first-order in the iteration variable) exactly.

10:06AM FC.00009 The mass, energy, space and time systemic theory— MEST, DAYONG CAO, Beijing Natural Providence Science & Technology Development Co., Ltd — The solar system is mass-energy center, and the wave (space-time) and planet are around. Sun absorb the matter (mass-energy) and radiate the light (space-time). It’s space-time has a space time structure. It has a positive curvature and a spherical structure. The dark hole system is the space-time center, and the dark mass-energy and dark planet (dark comet) are around. Dark hole absorb the light (space-time), and radiate the dark mass-energy (mass-energy). The dark mass-energy main make up of the negative proton and the negative neutron who can take negative density and negative pressure. The dark mass-energy has a dark mass-energy structure. It is a negative curvature and a inverse spherical structure. The general relativity equation, \(R_{ik} = \frac{1}{2}g_{ik}R = -\kappa T^i_k\). The left of the equation is the metric tensor of the space-time structure; the right of the equation is the energy-momentum tensor. The dark hole has the below equation, \(R_{ik} = \frac{1}{2}g_{ik}R = -\kappa T^i_k\). The left of the equation is the metric tensor of the dark mass-energy structure; the right of the equation is the dark space-time (field) tensor. The above equation show that the cosmological model is a balance system. The star system and the dark hole system are the uniform distribution. There is the transmutation and the interaction between the dark hole system and star system.
10:45AM GA.00001 The APS Minority Bridge Program\textsuperscript{1}, THEODORE HODAPP, American Physical Society — Physics has one of the lowest participation rates for underrepresented minorities and women of all Science, Technology, Engineering and Mathematics (STEM) fields. Things are improving for women and while still not representative of the population, the trends have been encouraging. Underrepresented minorities, however, have not been as fortunate. I will describe the current status of participation in physics, and a new program being launched by the American Physical Society that aims to significantly increase the number of minorities who receive PhDs in physics. The Minority Bridge Program is bringing together representatives from doctoral granting institutions and universities that educate minority students to establish a set of model programs based on the successes of existing efforts and capitalizing on the strengths of the American Physical Society. Our goal is to improve graduate education for all students by improving the opportunities for minority students.

\textsuperscript{1}This material is based upon work supported by the NSF under Grant No. 095833. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the NSF.

11:15AM GA.00002 The Fisk-Vanderbilt Masters to PhD Bridge Program: Increasing Diversity in Physics, DAVID ERNST, Vanderbilt University — The Fisk-Vanderbilt Masters to PhD Bridge program, a program which presently has more than thirty minority students in the pipeline headed for a PhD in physics or material science, and now including biology, will be described. A history of the program will be given, and the present status of the program described, including some metrics for measuring success. Our best understanding of the ingredients that have been necessary for the program to succeed will be discussed. Future plans will be described, and the speaker’s view of the long-term future will be presented.

11:45AM GA.00003 Preparing Minority Students for Graduate School: The Model of the Timbuktu Academy\textsuperscript{1}, DIOLA BAGAYOKO, Southern University and A&M College in Baton Rouge — The Timbuktu Academy is a comprehensive, systemic mentoring program at Southern University and A&M College in Baton Rouge (SUBR), Louisiana. We define systemic mentoring as one that is woven into the core functions of an organization. For most universities, those functions include instruction, research, and service. While the Academy has programs for pre-college and graduate students, its Ten-Strand Systemic Mentoring Model was specifically tailored to undergraduate education. We discuss the paradigm, programs, activities and results of the Timbuktu Academy. The proper implementation of the Ten-Strand Systemic Mentoring Model couples teaching and superior learning, on the one hand, and integrates research and education, on the other hand. For undergraduate education, key strands include support (financially or otherwise), scientific advisement, research participation (academic year or summer), immersion in a professional culture, monitoring, and guidance to graduate school. From the summer of 1994 to 2009, the Academy has engaged 2,083 pre-college scholars in its summer programs. To date, the Academy has assisted in the production of one hundred seventy (170) minority undergraduate scholars who have earned a Bachelor of Science degree. Seventy (70) of 83 physics graduates, twenty (20) of 29 chemistry graduates, and twenty-two (22) of 49 engineering graduates have earned graduate degrees or are successfully enrolled in graduate school, with emphasis on the pursuit of the Ph.D. For the above model and results, the Timbuktu Academy received the 2002 U.S. Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring and the Benjamin Banneker Legacy Award in 2007. The handouts accompanying this presentation are intended to facilitate the adaptive replication of the Timbuktu Academy by individuals, departments, colleges and universities and other organizations.

\textsuperscript{1}The Timbuktu Academy has been funded by the Department of the Navy, Office of Naval Research, the National Science Foundation, NASA and the ExxonMobil and Siemens Foundations.

12:15PM GA.00004 Minorities Road to Graduate School: The Xavier Experience, ANDERSON SUNDA-MEYA, Xavier University of Louisiana — During the past decade, Xavier University of Louisiana has ranked first nationally in the number of African American students who have earned undergraduate degrees in biology, chemistry, physics, and the physical sciences overall. Recent data shows that Xavier also ranks 8th in the nation in producing African American students who go on to earn science and engineering PhDs. A look at Xavier’s “way” will examine several components that contribute to its success: pre-college preparation, recruitment programs, admissions policies, financial assistance, and academic monitoring programs. By promoting comprehensive recruitment and retention strategies and by leveling the playing field, Xavier experience may offer a paradigm and a model for increasing the pool of motivated, talented and well-prepared minority applicants ready to tackle the rigors of a graduate level education in physics.

10:45AM GB.00001 Effect of Polymer Conformation on Wrapping with Carbon Nanotubes\textsuperscript{1}, OLAYINKA OGUNRO, SESAPS — We have employed first-principles density-functional calculations for investigating the effect of polymer conformations on the helical wrapping of carbon nanotubes and the selective enhancement of individual carbon nanotubes. Our attention is directed to the electronic structure effects associated with the polymer conformations. The calculation results are compared with the experimental investigations of using poly[(p-phenylenevinylene)-co-(p-phenyleneethynylene)] (PPE/PPV) for selecting specific single-walled carbon nanotubes.

\textsuperscript{1}In collaboration with Xiao-Qian Wang, Clark Atlanta University.

11:15AM GB.00002 Parallel fabrication of CMOS compatible single walled carbon nanotube field effect transistor and single electron transistor devices\textsuperscript{1}, SAIFUL KHONDAKER — Parallel fabrication of Complementary Metal Oxide Semiconductor (CMOS) compatible single walled carbon nanotube (SWNT) electronic devices is of great importance for nanoelectronic applications. Here we will summarize our recent progress on the fabrication of SWNT field effect transistors (FETs) and single electron transistors (SETs) with high yield using high quality SWNT aqueous solutions in combination with AC dielectrophoresis. We will show high quality FET devices using individual as well as aligned arrays of SWNTs. We will also demonstrate controlled fabrication and low temperature electron transport properties of SWNT SETs using a novel mechanical templating technique that we have recently developed.

\textsuperscript{1}This work is partially supported by US National Science Foundation under grant ECCS-0748091 (CAREER).
11:45AM GB.00003 Solid phase of Krypton on a carbon nanotube, SILVINA GATICA, Howard University — Krypton is known to form commensurate (CS) and incommensurate (IS) solid phases on top of flat graphite. Similar phases are expected to form on the surface of a carbon nanotube (NT), provided that the radius (R) is large enough. For smaller radii, the increasingly important effect of the curvature would eventually alter qualitatively the phase diagram preventing some phases and/or allowing new ones. Recently obtained experimental results of the adsorption of Kr and Ar on a single nanotube, show several quite remarkable, nearly vertical transitions. Those steps are observed and interpreted as cylindrical surface analogues of 2D monolayer transitions: vapor to commensurate solid (CS) and to an incommensurate solid (IS) phase coating the nanotube’s surface. Our Monte Carlo simulations for Krypton and Argon on the external surface of an isolated single-walled carbon nanotube show an IS phase comparable to the experiment, however with a different density that may be attributed to an underestimated strength of the potential used in the simulations. In the simulations for Kr, a CS is also found provided that the potential used is anisotropic.

12:15PM GB.00004 Quantum transport in carbon nanorings for metamaterials applications, MARK JACK, Florida A&M University, Physics Department — Central theme of this theoretical study is quantum transport on carbon nanoring surfaces under microwave illumination and the transmission of electromagnetic energy across a two-dimensional array of properly aligned toroidal carbon nanotubes for metamaterial applications. In a classical description, electromagnetically driven electronic surface currents in the rings will themselves generate in multiple radiation to interfere with an incoming polarized wave front, which may lead to new optical response characteristics created e.g. by the chiral features of the underlying mesoscopic structures. Possible applications ranging from quantum computing to new energy harvesting technologies could be envisioned. At these mesoscopic scales however a proper quantum mechanical treatment of these coherent electronic oscillations in form of surface plasmon-polaritons (SPPs) that travel along the toroidal surfaces is necessary. The main effects of SPPs in charge transport can be described in a simplified Hubbard model that allows a generalization of single-electron tightbinding transport calculations in a non-equilibrium Green’s function formalism. An existing Fortran code is being expanded to include these quantum many-body effects by calculating the transport Green’s function G using highly optimized, parallel matrix inversion routines in an object-oriented C++ code with the ŠcalAPACK library on NSF TeraGrid resources (TACC). Multiparticle quantum effects can thus be treated accurately and quickly for realistic device sizes of few 10,000 carbon atoms or more. The influence of different torus dimensions and relative alignments may be studied on how electromagnetic energy is stored and transmitted across the metamaterial. Additionally, in a collaboration with the Georgia Institute of Technology the influence of electron-photon coupling on transport for low-energy vibrational modes is investigated, crucial for understanding true nanodevice performance, including dissipation. This project was partially supported as a summer research project under the 2010 NCSI/Shader Petascale Computing Undergraduate Summer Internship and the 2010 NSF TeraGrid Pathways Summer Faculty Fellowship Program.

Friday, October 22, 2010 10:45AM – 12:09PM — Session GC Atomic, Molecular, and Optical Physics Nicholson Hall 118

10:45AM GC.00001 Charge exchange in slow collisions of Si3+ with H1, D.C. JOSEPH, B.C. SAHA, Department of Physics, Florida A&M University, Tallahassee, FL-32307 — Low energy electron capture from atomic hydrogen by multi-charged ions continues to be of interest and has wide applications including both magnetically confined fusion and astrophysical plasmas. The charge exchange process reported here, Si3++ H → Si3+ H+ is an important destruction mechanism of Si3+ in photo-ionized gas. The soft X-ray emission from comets has been explained by charge transfer of solar wind ions, among them Si3+++, with neutrals in the cometary gas vapor. The state selective cross sections are evaluated using the semi-classical molecular orbital close coupling (MOCC) [1] methods. Adiabatic potentials and wave functions for a number of low-lying singlet and triplet states are calculated using the MRD-CI package [2]. Details will be presented at the conference. [1] M. Kimura and N. F. Lane, At. Mol. Opt. Phys 26, 79 (1990). [2] R. J. Buenker, “Current Aspects of Quantum Chemistry” 1981, Vol 21, edited by R. Carbo (Elsevier, Amsterdam) p 17.

1Work supported by NSF CREST project.

10:57AM GC.00002 Measurement of the fourth O-H overtone absorption cross section in acetic acid using cavity ring-down spectroscopy, SOLOMON BIBILIGN, ISRAEL BEGASHAW, MARC M. FIDDLER, Department of Physics, North Carolina A&T State University — We report the measured absorption cross sections of the fourth O-H overtone in acetic acid using cavity ring-down spectroscopy. The cross sections enable the calculation of the reaction rate J for O-H overtone initiated reactions, such as dissociation and deactivation. The contributions to the acetic acid spectrum from the monomer and dimer have been separated. The absorption of acetic acid monomer peaks at about 615 nm and has a peak cross section of 1.8×10^{-24} cm^{2} molecule^{-1} cm^{-1}. Between 612 and 620 nm, the integrated cross section for the acetic acid monomer is (5.23±0.73)×10^{-25} cm^{2} molecule^{-1} nm or (1.38±0.19)×10^{-22} cm^{2} molecule^{-1} cm^{-1}.

1We acknowledge the support from NOAA under the cooperative agreement NA06OAR4810187.

11:09AM GC.00003 The Terahertz Spectrum of the v5/2v9 Dyad of Nitric Acid, PAUL HELMINGER, University of South Alabama, DOUGLAS T. PETKIE, Wright State University, IVAN MDEVDEV, FRANK C. DE LUCIA, Ohio State University — Because nitric acid is an important molecular species in the ozone cycle in the upper atmosphere, it has been the subject of many studies in both the infrared and microwave regions of the spectrum. Microwave studies of the rotational spectrum of nitric acid in exited states contributed both to the understanding of this fundamental molecule and to the construction of accurate spectral maps for remote sensing. Our most recent work on nitric acid includes studies of the terahertz spectrum of the ground state and four lowest-energy excited vibrational states. We have now extended this work to include measurements and analysis of the rotational transitions of the v5/2v9 dyad of nitric acid. This very complex spectrum includes torsional splitting of both states and Fermi and Coriolis type interactions between them. Preliminary results of the assignment and analysis will be reported.

1This work is supported by a grant from NASA.

11:21AM GC.00004 ABSTRACT WITHDRAWN —

11:33AM GC.00005 Generation of vacuum squeezing fields via self-rotation in Rb vapor, KEBEI JIANG, ROBINJEE SINGH, PETR ANISIMOV, Louisiana State University — As the first part of our "Sub-shot noise limited quantum atomic magnetometer" program, this paper proposes a theoretical method of generating the source for the fore-mentioned magnetometer—vacuum squeezing field induced by self-rotation in Rb vapor. We derive a full quantum mechanical description, in contrast with previous semi-classical work, for such a field-atom system. Finally, considering self-rotation as a classical phenomenon, we explains its relation with vacuum squeezing in detail.
This novel device completes the many-decades-old task of developing simple techniques for measuring essentially all laser pulses. Measuring ns pulses has proved much more difficult than measuring fs and ps ones. Happily, we have recently demonstrated a novel FROG for measuring ns lasers, pulsed diode lasers, and high-power fiber lasers and amplifiers are often far from ideal in time and no one knows precisely what their distortions look like. While we must also be so in time. Fortunately cameras could measure the beam quality, which then rapidly improved. Just as lasers must be smooth and stable in space, they must also be so in time. Fortunately, electronic detectors and oscilloscopes could measure the laser intensity vs. time. Until, that is, researchers began to hunt through the book to find an example problem to use as a (perhaps inappropriate) template, and the classic “plug-n-chug” mentality. Studies in science education and cognitive science have yielded rational explanations for many of these novice behaviors and lay a groundwork for instructors to aid their students in beginning to develop more expert-like skills and behaviors. A few examples of these studies, as well as curricular tools that have developed as a result, will be shared. These tools not only encourage students to try more expert-like strategies, but also prime them for developing conceptual understanding.

This work was funded by a 2007 Hewlett-Packard Technology for Teaching Grant.

This novel device completes the many-decades-old task of developing simple techniques for measuring essentially all laser pulses. We present our theoretical study of the sensitivity and resolution of phase measurement, in a Mach-Zehnder interferometer with coherent light and squeezed vacuum inputs, using parity detection. Mixing coherent light and squeezed vacuum has been previously shown to produce N00N-like states inside the interferometer, which suggests a near Heisenberg-limited phase sensitivity. Our results comply with the above observation at high photon numbers. Given a recently shown implementation of parity detection using homodyne detection, we propose an experiment for phase super-sensitivity with high photon flux.
imaging deconvolution techniques, it becomes possible to locate known and unknown sources with spatial resolution to
Coupling this to the ∼identified sources. We present an indirect imaging method that permits searching for unknown sources by applying the Differential Filter Technique (DFT)
a powerful wide-field monitoring capability, the BATSE and GBM implementations of the technique have so far limited the analysis to a catalog of previously
sources over the entire sky. The technique has been demonstrated with the Burst And Transient Source Experiment (BATSE) on the Compton Gamma

in nearly all fields of physics, from high temperature superconductors to neutron stars, the quark-gluon plasma of the Big Bang, and even string theory.

an occultation step while damping background and providing an estimate of the intensity from that grid point. Results using GBM will be presented.

the coverage is not uniform. The standard analysis relies on a catalog of known sources for obtaining occultation times and flux measurements. To search for
behind) the Earth, a step-like feature occurs in the detector count rate. The

from behind) the Earth, a step-like feature occurs in the detector count rate. The

The 12 sodium iodide (NaI) detectors that provide the hard x-ray (8-1000 keV) coverage for the Fermi satellite mission’s Gamma-Ray

This work is supported in part by NASA Fermi Guest Investigator grant NNX09AH60A, NASA/Louisiana Board of Regents Agreement NASA/LEQSF (2005-2010)-LaSPACE, and LEQSF(2007-2012)-GF-04.

The 12 sodium iodide (NaI) detectors that provide the hard x-ray (8-1000 keV) coverage for the Fermi satellite mission’s Gamma-Ray

We acknowledge support by the National Institutes for Health (R21 RR19770, 1RC1CA145105), the Duke Institute for Brain Sciences, and Duke University.

This work has been supported by NSF, ARO, and DOE.

Friday, October 22, 2010 1:30PM - 3:30PM –
Session HC Astrophysics: Gamma Rays, Supernovae, and Black Holes Nicholson Hall 118

This work is supported in part by NASA Fermi Guest Investigator grant NNX09AH60A, NASA/Louisiana Board of Regents Agreement NASA/LEQSF (2005-2010)-LaSPACE, and LEQSF(2007-2012)-GF-04.

This work is supported in part by NASA/Louisiana Board of Regents Cooperative Agreement NASA/LEQSF (2005-2010)-LaSPACE.
1:54PM HC.00003 Monitoring the > 100 keV Gamma-Ray Sky Using GBM: The First Two Years

G.L. CASE, Louisiana State University; A. CAMERO-ARRANZ, Fundación Española de Ciencia y Tecnología, Spain; V. CHAPLIN, University of Alabama, Huntsville; M.L. CHERRY, Louisiana State University; M.H. FINGER, USRA; P. JENKE, NASA/Marshall Space Flight Center; J. RODI, Louisiana State University; C.A. WILSON-HODGE, NASA/Marshall Space Flight Center — The Gamma-Ray Burst Monitor (GBM) onboard Fermi is being used to monitor hard x-ray/soft gamma-ray sources in the energy range of 8-1000 keV using the Earth occultation technique. Through the first two years of this monitoring program, eight sources have been detected at energies above 100 keV, including six persistent sources (Crab, Cyg X-1, Cen A, 1E 1740-29, SWIFT J1753.5-0127, and GRS 1915+105) and two transients (XTE J1752-223 and GX 339-4). Light curves of all eight sources using the GBM 8-channel CTIME data are presented along with discussion of the high energy behavior.

2:06PM HC.00004 Ground-Based Observations of Terrestrial Gamma-Ray Flashes

R.A. RINGUETTE, N. CANNADY, G.L. CASE, M.L. CHERRY, D. GRANGER, J. ISBERT, M. STEWART, Dept. of Physics & Astronomy, Louisiana State University, Baton Rouge, LA 70803 — First seen from space by the BATSE gamma ray telescope in the 1990s, Terrestrial Gamma-ray Flashes (TGFs) consist of extremely fast bursts of high energy (up to 40 MeV) gamma rays correlated with intense lightening from thunderstorms. Spacecraft experiments are sensitive to very large events, but ground-based detectors closer to the thunderstorms may provide data on the intensity spectrum of smaller events. Four detectors consisting of NaI scintillators viewed by photomultipliers have been placed on rooftops at LSU’s Baton Rouge campus to monitor TGFs. The setup and design of the ground-based experiment will be discussed.

3:06PM HC.00009 Magnetized Equilibrium Accretion Tori around Kerr Black Holes in General Relativistic Framework

Supported by NSF grants DGE-0504507 and OCI-0905046 and TeraGrid Allocation TG-MCA02N014.

2:18PM HC.00005 Accretion-Induced Collapse of White Dwarfs

ERNAZAR ABDIKAMALOV, CCT LSU, CHRISTIAN OTT, California Institute of Technology; LUCIANO REZZOLLA, Albert Einstein Institute, LUC DESSART, Laboratoire d’Astrophysique de Marseille; HANS-CHRISTIAN BESSON, Max Planck Institute for Astrophysics — The accretion-induced collapse (AIC) of a white dwarf may lead to the formation of a protoneutron star and a supernova explosion. This process represents a path alternative to thermonuclear disruption of accreting white dwarfs in Type Ia supernovae. In the AIC scenario, the supernova explosion energy is expected to be small and the resulting transient short-lived, making it hard to detect by electromagnetic and neutrino means alone. Gravitational-wave observations may provide crucial information necessary to reveal a potential AIC. In this talk, I present results from recent numerical simulations of AIC. I will discuss the prospects for observing electromagnetic and gravitational wave signal from AIC.

2:30PM HC.00006 Dust Formation in Core Collapse Supernovae

JENNIFER ANDREWS, GEOFFREY CLAYTON, Louisiana State University — Recent detections of large amounts of dust in high redshift galaxies suggest that core collapse supernovae (CCSNe) may play an important role in the dust budget of the universe. At an age of only 1 Gyr, there has been not been enough time for low-mass stars to form and evolve to the asymptotic giant branch, but there has been sufficient time for CCSNe, which quickly evolve and return their material to the surrounding interstellar medium. For the past three years, we have been following numerous, nearby CCSNe with Gemini, HST, and Spitzer to look for indications of dust formation, which appear within the first few years of explosion. With our dataset containing large temporal and wavelength coverage, we have discovered unusual and interesting results. I will discuss these results and their implications for SNe as major dust contributors in the universe.

2:42PM HC.00007 General initial data for simulations of compact binary systems

FRANK LÖFFLER, University of California, Los Angeles; ROLAND HAAS, TANJA BODE, Georgia Institute of Technology; BRUNO MUNDIM, Rochester Institute of Technology — Some of the most energetic events in astrophysics are believed to be connected to the interaction and merger of compact binaries, consisting of neutron stars and/or black holes. Yet, there are still a lot of uncertainties, especially on binaries involving at least one neutron star. General relativistic effects have to be taken into account when studying these compact objects, which make analytic studies very hard. Computer simulations of binaries of neutron stars and/or black holes typically solve Einstein’s equations of General Relativity and a system of hydrodynamics equations in order to obtain a time sequence. However, the initial data needed to start this sequence also has to satisfy a set of elliptic constraint equations. Solving these equations is difficult for general initial configurations, which is why most solvers are restricted to a very narrow set of parameters. In this talk, we describe one method of generating initial data for compact binary systems, leaving most of the parameters, such as momenta and spins, free to choose.

3:00PM HC.00009 Magnetized Equilibrium Accretion Tori around Kerr Black Holes in General Relativistic Magneto-hydrodynamic Simulations

Supported by NSF #0707691 and NASA GSRP grant NNX08AV36H. This work is based in part on observations made with the Spitzer Space Telescope, which is operated by the JPL, CalTech.

3:20PM HC.00010 Non-axisymmetric Instabilities in Thick Self-Gravitating Tori around Black Holes in Dynamical General Relativistic Framework

OLEG KOROBKIN, ERIK SCHNETTER, Department of Physics and Astronomy, Louisiana State University; NIKOLAOS STERGIOLAS, Aristotle University of Thessaloniki, Greece; BURKHARD ZINK, University of Tuebingen, Germany; ERNAZAR ABDIKAMALOV, Center for Computation and Technology, Louisiana State University — Thick self-gravitating accretion disks around black holes play a major role in several astrophysical scenarios of gamma-ray bursts. These objects can form as a result of massive star core collapse, merger of two neutron stars or a neutron star and a black hole, they have very high densities and relativistic rotation speeds. In this study, we address stability of thick constant angular momentum accretion tori using a fully dynamical general relativistic framework. We have performed evolutions of several accretion tori models and identified two distinct types of non-axisymmetric instabilities. The first type corresponds to the Papaloizou-Pringle instability, enhanced by a motion of the central black hole. The second type corresponds to the l-mode, previously found in Newtonian studies. We discuss the types, growth rates and pattern speeds of the unstable modes, as well as the detectability of the gravitational waves from such objects.

3:40PM HC.00011 Monitoring the > 100 keV Gamma-Ray Sky Using GBM: The First Two Years

This work is supported by NASA/Louisiana Board of Regents Cooperative Agreement NASA/LEQSF (2005-2010)-LaSPACE.

4:00PM HC.00013 Monitoring the > 100 keV Gamma-Ray Sky Using GBM: The First Two Years

This work is supported by NSF grants AST-0707691 and NASA GSRP grant NNX08AV36H. This work is based in part on observations made with the Spitzer Space Telescope, which is operated by the JPL, CalTech.

4:20PM HC.00014 Monitoring the > 100 keV Gamma-Ray Sky Using GBM: The First Two Years

This work is supported by NSF grants AST-0707691 and NASA GSRP grant NNX08AV36H. This work is based in part on observations made with the Spitzer Space Telescope, which is operated by the JPL, CalTech.
of the number of layers, the magnetic order of the ground states can be complex and non-collinear.

The bi-layered ZGNR with α-alignment edges is non-magnetic; while that of the tri-layered ZGNR with α-alignment edges is magnetic even with structural deformation only happens in layered ZGNRs with α-alignment edges; the ground state of the system depends on the energy fluctuation of the system.

1:54PM HD.00003 Temperature and viscosity effects on the velocity profile of a nanochannel electro-osmotic flow1, BOHUMIR JELINEK, SERGIO D. FELICELLI, Mississippi State University, PAUL F. MLAKAR, JOHN F. PEETERS, ERDC, Vicksburg MS — Significant temperature and viscosity effects on the electrokinetic transport in a nanochannel with a slab geometry are demonstrated using a molecular dynamics (MD) model. A previously studied system consisting of Na+ and Cl− ions dissolved in water and confined between fixed crystalline silicon walls with negatively charged inner surfaces in an external electric field was investigated. Lennard-Jones (LJ) force fields and Coulomb electrostatic interactions with Simple Point Charge Extended (SPC/E) model were used to represent the interactions between ions, water molecules, and channel wall atoms. Dependence of the flow of water and ions on the temperature was examined. The magnitude of the water flux and even its direction are shown to be significantly affected by temperature. Temperature dependence of the flux was attributed to the charge redistribution and to the changes in viscosity of water. Using a simple inverse power approximation for water viscosity profile across the channel instead of constant viscosity, an improved prediction of MD electro-osmotic velocity profile from charge density by Stokes equation is demonstrated.

This work was funded by the US Army Corps of Engineers.

1:06PM HD.00004 Modeling of Fluid Flow and Heat Transfer in Nanotube and Nanowire Forests, MICHAEL MARTIN, Louisiana State University — Bundles of nanotubes, also known as nanotube forests, are under consideration for applications such as chip cooling and pre-concentrators for biodetection. Scaling law analysis shows that the air flow through these forests at atmospheric pressure is in the free-molecular flow regime. Based on the linearized free-molecular flow equations, a model is presented for the pressure drop and heat transfer in these systems. The momentum and energy equations are coupled, requiring that they be solved simultaneously. Results show large pressure drops, and a non-linear pressure distribution, similar to that seen in rarefied micro-channel flows.

2:18PM HD.00005 Fluid Flow and Heat Transfer in Polygonal Micro Heat Pipes, SAI SASHANKH RAO, HARRIS WONG, Department of Mechanical Engineering, Louisiana State University, Baton Rouge, Louisiana, USA — Micro heat pipes have been used to cool micro electronic devices, but their heat transfer coefficients are low compared with those of conventional heat pipes. A typical micro heat pipe has a long and narrow cavity of polygonal cross section. A long vapor bubble occupies the center of the cavity, while the liquid fills the rest. As one end of the pipe is heated, the liquid evaporates and increases the vapor pressure. The higher pressure drives the vapor to the cold end where the vapor condenses and releases the latent heat. The condensate moves along the liquid-filled corners of the pipe back to the hot end to complete the cycle. We solve the steady-flow problem assuming a small imposed temperature difference between the two ends of the pipe. This leads to skew-symmetric fluid flow and temperature distribution along the pipe so that we only need to focus on the evaporative half of the pipe. Since the pipe is slender, the axial flow gradients are much smaller than the cross-stream gradients. Thus, we can treat the evaporative flow in a cross-sectional plane as two-dimensional. Analytic solutions are derived for the temperature distribution and fluid flow along the pipe. Our model provides an explanation for the comparatively low effective thermal conductivity in micro heat pipes, and points to ways to improve their heat transfer capabilities.

2:30PM HD.00006 Simulation of Heating in Nano-Electro Mechanical (NEMS) Bridges, ELHAM MAGHSOUDI, MICHAEL MARTIN, Louisiana State University — Heat transfer in a thermally actuated doubly clamped bridge is simulated using a Finite Difference Method. These results are used to investigate the effect of convective cooling on the mechanical response of the system, defined as the displacement. The system is a doubly clamped beam with a length of 10 microns, a width of 1 micron, and a thickness of 300 nanometers, in air with a pressure from 0.01 Pa to 2 MPa. Conduction along the beam as well as convection between the beam and the gas are considered. A constant heat load is applied to the top of the beam. Both free molecular and continuum approaches are considered to define the convective coefficient. Simulations are performed for three different materials: silicon, silicon carbide, and diamond. The numerical results show that the displacement and the response of thermally actuated nano-scale devices are strongly influenced by ambient cooling. These results are scaled using the Biot number. The mechanical response of the system depends on the material properties and the Biot number.

2:42PM HD.00007 Structural and magnetic stabilization of edges of layered zigzag graphene nanoribbons1, JUN-QIANG LU, University of Puerto Rico at Mayaguez, YANNA ZHANG, XIAO-LI LU, YONGJIN JIANG, BOTAO TENG, Zhejiang Normal University — We report first-principle study on structural and magnetic stabilization of bilayer and trilayer zigzag graphene nanoribbons with two different edge alignments. Our results showed that (I) structural deformation only happens in layered ZGNRs with a−alignment edges; the ground state of the bi-layered ZGNR with a−alignment edges is non-magnetic; while that of the tri-layered ZGNR with α-alignment edges is magnetic even with structural deformation; (II) layered ZGNRs with β-alignment edges are always flat and have magnetic ground states; (III) the intra-layer magnetic order in a layered ZGNR is always antiferromagnetic near each edge regardless of edge alignment and number of layers, as long as its ground state is magnetic; (IV) with the increasing of the number of layers, the magnetic order of the ground states can be complex and non-collinear.

1 JQL acknowledges the start-up support from the Institute for Functional Nanomaterials, University of Puerto Rico.
2:54PM HD.00008 Two-dimensional phase of gases physisorbed on a graphene. HYE-YOUNG KIM, Department of Chemistry and Physics, Southeastern Louisiana University, LOUIS BRUCH, Department of Physics, University of Wisconsin-Madison, MILTON COLE, Department of Physics, Pennsylvania State University — The phases of gases physically adsorbed on a suspended, free-standing graphene are explored. In particular, three kinds of phase transitions are examined: (1) The quasi-two-dimensional condensation of a van der Waals fluid, (2) Contribution of the substrate-mediated interaction energy to the ground state energy of monolayer solid and liquid phases of He on graphene, and (3) Wetting transition of water and other fluids on graphene. In each case, the difference from those for adsorption on graphite will be presented.

3:06PM HD.00009 High Density Bio-Nano Device Fabrication with Supramolecular NanoStamping. MAITRI DESAI, Augusta State University, ROBYN CROSS, Spelman College, KEITH CARROLL, JENNIFER CURTIS, Georgia Institute of Technology — DNA microarrays are miniature complex devices that organize a high density of genetic information for biomedical applications such as genetic screening. Fabrication of DNA microarrays can be realized with different micropatterning methods such as microcontact printing and Thermochemical Nanolithography (TCNL). Recently, a low cost, high-throughput technique called supramolecular nanostamping (SuNS) has been developed to allow replication of DNA arrays by means of hybridization, contact to secondary surface, followed by dehybridization. However, the initial microarrays used for SuNS suffer from poor DNA density and the ability to make nanoscale resolution arrays practically. Our work focuses on combining the advantages of TCNL, which overcome these limitations, with SuNS. This will provide an ideal microarray fabrication process. To expedite the development stage, we have established a working SuNS protocol for our TCNL surfaces using microcontact printing rather than the more difficult, expensive TCNL. Once the SuNS is performed successfully and repeatedly using microcontact printing, ultimately, we will apply this method to nano resolution TCNL patterns and consequently combine TCNL and SuNS.

3:18PM HD.00010 Integrated surface plasmon resonance spectral sensing using super-periodic nanohole array. HAIHENG LEONG, JUNPENG GUO, YONGBIN LIN, ROBERT LINDQUIST, University of Alabama Huntsville, DAVID BRADY, Duke University — We will report the demonstration of an integrated surface plasmon resonance spectroscopic chemical sensors using patterned nanohole arrays. (1) Center on Materials and Devices for Information Technology Research

Friday, October 22, 2010 3:45PM - 5:45PM – Session JA Microfluidics: Computational and Experimental Challenges Nicholson Hall 119

3:45PM JA.00001 Counter-flow Microfluidics for Stable Flow Thermodynamics. NIEL CREWS, Louisiana Tech University — Microfluidic thermal reactors are able to achieve high temperature ramping rates due to their low thermal mass. Of these, the most thermodynamically efficient are flow systems that rely on a steady-state temperature distribution to induce temperature change of the moving fluid. Rather than inserting or extracting heat at controlled time intervals, the fluids are heated and cooled only through local heat transfer with the substrate material in which the microchannels are embedded. In addition to accelerated ramping and reduced energy consumption, such systems have the potential to provide greater control of the heating rates. This is because the temperature change is simply a function of the fluid velocity vector with respect to the stable temperature distribution within the material. However, the operation of such a system is complicated by the thermal perturbation that the fluid flow introduces into the system. When predicting the temperature change of the fluid, it is common to ignore the effect of the fluid flow on the original temperature distribution within the substrate. However, this has been shown to be the dominant behavior in many scenarios. This behavior is particularly problematic in polymeric microfluidic devices, where thermal conductivities are on the order of 0.2 W/m-K. This presentation will address a powerful solution to this thermal instability. By implementing a counter-flow microfluidic geometry, it will be shown how the temperature smearing common to microflow thermal reactors can be virtually eliminated. The deleterious effect of the insulative properties of popular polymer substrates is minimized, allowing for higher flow rates and temperature ramp rates. This is achieved by creating a preferred heat path for the thermal energy that is being driven into or out of the fluid during flow. Theory will be presented; experimental data will be discussed; application to lab-on-a-chip systems will be demonstrated.

4:15PM JA.00002 Quantized Concentration Gradient in Picoliter Scale. JONG WOOK HONG, Auburn University — Generation of concentration gradient is of paramount importance in the success of reactions for cell biology, molecular biology, biochemistry, drug-discovery, chemotaxis, cell culture, biomaterials synthesis, and tissue engineering. In conventional method of conducting reactions, the concentration gradients is achieved by using pipettes, test tubes, 96-well assay plates, and robotic systems. Conventional methods require milliliter or microliter volumes of samples for typical experiments with multiple and sequential reactions. It is a challenge to carry out experiments with precious samples that have strict limitations with the amount of samples or the price to pay for the amount. In order to overcome this challenge faced by the conventional methods, fluidic devices with micrometer scale channels have been developed. These devices, however, cause restrictions on changing the concentration due to the fixed gradient set based on fixed fluidic channels. Here, we present a unique microfluidic system that can generate quantized concentration gradient by using series of droplets generated by a mechanical valve based injection method. All this work has been done by Sachin Jambovane, Kim Cramer, Woon Seob Lee, and Hoon Suk Rho. The presenter would like to thank them.

4:45PM JA.00003 Multiphase flow modeling: A tool to aid in scale up of processes. KRISHNASWAMY NANDAKUMAR, Louisiana State University — Multiphase flows are ubiquitous in chemical processing industries. Traditional approach has been to ignore fluid dynamical effects by invoking simplifying assumptions of homogeneity, but pay the price during scale-up of processes. The question that I address is “Can Multiphase flow modeling come to our rescue in minimizing the need for pilot scale experiments?” On the fundamental side, we have developed algorithms for direct numerical simulation of multiphase flows. For dispersed rigid particles as in suspension flows, sedimentation etc, we couple the Navier-Stokes equations with the rigid body dynamics in a rigorous fashion to track the particle motion in a fluid. For deformable bubbles/droplets dispersed in another fluid, we also track their motion in an Eulerian grid. The two classes of algorithms show great promise in attempting direct simulation of multiphase flows, from which we can extract statistically meaningful average behavior of suspensions or bubbly flows. On the other hand, there is an immediate need to study flow of complex fluids of industrial importance. Such cases include polymer blending processes, erosion in pipelines and process vessels and mass transfer in packed beds. In such studies we use volume averaged equations as the basis of flow models coupled with experimental validation of such predictions in an effort to develop scale invariant closure models that are needed as part of the volume averaged flow models.

5:15PM JA.00004 μ-PIV/Shadowgraphy measurements to elucidate dynamic physicochemical interactions in a multiphase model of pulmonary airway reopening¹. EIICHIRO YAMAGUCHI, Tulane University — We employ micro-particle image velocimetry (μ-PIV) and shadowgraphy to measure the ensemble-averaged fluid-phase velocity field and interfacial geometry during pulsatile bubble propagation that includes a reverse-flow phase under influence of exogenous lung surfactant (Infasur). Disease states such as respiratory distress syndrome (RDS) are characterized by insufficient pulmonary surfactant concentrations that enhance airway occlusion and collapse. Subsequent airway reopening, driven by mechanical ventilation, may generate damaging stresses that cause ventilator-induced lung injury (VILI). It is hypothesized that reverse flow may enhance surfactant uptake and protect the lung from VILI. The microscale observations conducted in this study will provide us with a significant understanding of dynamic physicochemical interactions that can be manipulated to reduce the magnitude of this damaging mechanical stimulus during airway reopening. Bubble propagation through a liquid-occluded fused glass capillary tube is controlled by linear-motor-driven syringe pumps that provide mean and sinusoidal velocity components. A translating microscope stage mechanically subtracts the mean velocity of the bubble tip in order to hold the progressing bubble tip in the microscope field of view. To optimize the signal-to-noise ratio near the bubble tip, μ-PIV and shadow images are recorded in separate trials then combined during post-processing with help of a custom-designed microscale image scale marker. Non-specific binding of Infasurf proteins to the channel wall is controlled by oxidation and chemical treatment of the glass surface. The colloidal stability and dynamic/static surface properties of the Infasurf-PIV particle solution are carefully adjusted based on Langmuir trough measurements. The Finite Time Lyapunov Exponent (FTLE) is computed to provide a Lagrangian perspective for comparison with our boundary element predictions.

¹NIH R01-HL81266

Friday, October 22, 2010 3:45PM - 5:45PM – Session JB Interstellar Gas and Star Formation Nicholson Hall 109

3:45PM JB.00001 Herschel Observations of a Newly Discovered UX Ori Star in the Large Magellanic Cloud¹, GEOFFREY CLAYTON, Louisiana State University — The LMC star, SSTSAGE1C J050756.44–703453.9, was first noticed during a survey of EROS-2 lightcurves for stars with large irregular brightness variations typical of the R Coronae Borealis (RCB) class. However, the visible spectrum showing emission lines including the Balmer and Paschen series as well as many Fe II lines is emphatically not that of an RCB star. This star has all of the characteristics of a typical UX Ori star. It has a spectral type of approximately A2 and has excited an H II region in its vicinity. However, if it is an LMC member, then it is very luminous for a Herbig Ae/Be star. It shows irregular drops in brightness of up to 2 mag, and displays the reddening and “blueing” typical of this class of stars. Its spectrum, showing a combination of emission and absorption lines, is typical of a UX Ori star that is in a decline caused by obscuration from the circumstellar dust. SSTSAGE1C J050756.44–703453.9 has a strong IR excess and significant emission is present out to 50 µm. Monte Carlo radiative transfer modeling of the SED requires that SSTSAGE1C J050756.44–703453.9 has both a dusty disk as well as a large extended diffuse envelope to fit both the mid- and far-IR dust emission. This star is a new member of the UX Ori subclass of the Herbig Ae/Be stars and only the second such star to be discovered in the LMC.

¹NASA Herschel Science Center, JPL contract Nos. 1381522 and 1381650

4:15PM JB.00002 Translucent, High-Latitude, Molecular Clouds in the Milky Way. LORIS MAGNANI, University of Georgia — More than 100 molecular clouds are detected in the lowest rotational transition of carbon monoxide are known to exist at high Galactic latitudes (−b > 25 degrees; b = 0 degrees lies along the Galactic midplane). For the most part, these are located in the Galactic plane surveys (primarily Giant Molecular Clouds or GMCs). The high Galactic latitude and the thinness of the Galactic disk restrict the bulk of the high-latitude molecular clouds to be nearby (i.e., less than a few hundred parsecs away). The vast majority of these clouds are of the translucent variety that is, with dust opacities in the range of 1-5 magnitudes and a chemistry that is dominated by photoprocesses rather than collisional reactions. Translucent clouds differ from the more common GMCs and dark molecular clouds that are likely the local, high-latitude extension of the molecular distribution detected by the Galactic plane surveys. These clouds can enhance the formation of small objects in that they ionize the surrounding volume and allow the gas to cool by molecular line emission. The geometry of the Veil, the geometry of the Veil, and many other physical properties of the Veil. Overall, a picture develops of a region within two parsecs of the ionizing stars of Orion, a region dominated by magnetic pressure, and a region where H₂ molecules are in highly excited rotational/vibrational states.

4:45PM JB.00003 Orion’s Veil: A Laboratory for Understanding Physical Processes in the Interstellar Medium. NICK ABEL, University of Cincinnati, Clermont Campus — Orion’s Veil is a foreground cloud of gas and dust which is directly along the line of sight towards the Orion Nebula, and is the primary cause of extinction seen towards the Nebula. The wealth of spectroscopic data available for the Veil makes it an ideal case-study of physical processes in the Interstellar Medium (ISM). Radio observations (continuum and 21cm absorption) allow us to map the amount of extinction in the Veil, along with a map of the line-of-sight magnetic field. UV and optical absorption data of atoms and H₂ allow us to determine of abundances of elements in multiple stages of ionization, density, and temperature. In this talk, I will discuss the observations which make the Veil unique. I will also show how, by combining the observational with theoretical calculations using the spectral synthesis code Cloudy, we have determined the distance of the Veil from the ionizing stars of the Orion Nebula, the balance between magnetic, thermal, and gravitational energy in the Veil, the geometry of the Veil, and many other physical properties in the Veil. Overall, a picture develops of a region within two parsecs of the ionizing stars of Orion, a region dominated by magnetic pressure, and a region where H₂ molecules are in highly excited rotational/vibrational states.
explore the full exhibit’s reception by the general public. Visitors were asked to complete a survey about their experience at “Astronomy’s New Messengers,” and the presentation will report the survey results, and

gravitational waves and their possible sources, an interferometer, the space-time fabric model, and the difficulties in identifying a gravitational wave. The exhibit research project, it is both within its directive and within its best interest to educate and inform the public at large of its efforts. The Education and Public Observatory (LIGO) is an endeavor to directly confirm the existence of gravitational waves, funded by the National Science Foundation. As a publicly funded

Exhibition

the presenter will demonstrate an inquiry-based method employing clips from popular movies to learn physics. He will show movie clips from several different

Science teachers are challenged to compete with these seemingly unconquerable forces. One alternative to battling the influence of multimedia in its onslaught against the scientific minds of our youth is to embrace these monsters and tame them. By relating what the students know best (who kissed who in Walk the

against the scientific minds of our youth is to embrace these monsters and tame them. By relating what the students know best (who kissed who in Walk the

1 Support from NSF grant AST-0807305 is gratefully acknowledged.

Friday, October 22, 2010 3:45PM - 4:57PM — Session JC Physics Education Nicholson Hall 118

3:45PM JC.00001 Teaching Temperature with Technology MICHALE SCHILLACI1, University of South Carolina — In recent years it has become very popular to introduce computational tools and/or simulations into the classroom. While the intention of this classroom addition is often meant to help elucidate a particular physical phenomena, teachers at ALL levels — whether graduate or undergraduate, secondary- or middle-school — may miss important teaching moments by either relying upon or struggling with the technology! I will demonstrate this phenomena with a sample teaching module developed at our institution that seeks to discover the relationship between temperature and latitude by having students gather data (e.g., average monthly temperature for a chosen city) from various world wide web resources. This task may be very difficult for students and teachers for reasons ranging from slow connection speeds to an inability to plot and interpret data. I will wrap up by demonstrating a simple Maple routine that will produce the graphs easily and discuss ways in which this kind of top-down solution may be the best bet for using and teaching technology at all levels.

3:57PM JC.00002 Spotting fake videos with Tracker Video Analysis RHETT ALLAIN, Southeastern Louisiana Univ. — Is that youtube video real or fake? This question comes up all the time. In this talk, I will briefly introduce Tracker Video Analysis (a free, java-based application) and show how it can be used to determine the validity of videos.

4:09PM JC.00003 Grade Level Expectations: Do They Prepare Students for Introductory College Chemistry?1, M.M. DAVIES, Denham Springs High School, Denham Springs, LA 70726 — The Grade Level Expectations (GLES) established by the Louisiana Department of Education are intended to ensure that students are prepared for introductory college level chemistry. A sample of students in an introductory Chemistry class at Louisiana State University were tested to confirm that knowledge of the GLES (chemical concept inventory pre-test and post-test score and normalized gain) correlated with performance in CHEM 1201 (average exam score and final exam score). No significant correlations were found. In-state Louisiana public school students and out-of-state/private school students were then considered separately with the assumption that Louisiana public school students were educated using the GLES as the framework for their Chemistry education while out-of-state/private school students were not. It was determined that both groups of students performed statistically similarly in every category with the exception of their final exam score, with the out-of-state/private school students performing better.

1 This work is supported in part by Louisiana Board of Regents Grant LEQSF(2008-10)-ENH-TR-05 and NSF grant 0928847.

4:21PM JC.00004 Effective Lesson Planning: Field Trips in the Science Curriculum1, C.R. RIEGER, Woodlawn Middle School, Baton Rouge, LA 70817 — Science field trips can positively impact and motivate students. However, if a field trip is not executed properly, with appropriate preparation and follow-up reinforcement, it can result in a loss of valuable educational time and promote misconceptions in the students. This study was undertaken to determine if a classroom lesson before an out-of-the-classroom activity would affect learner gain more or less than a lesson after the activity. The study was based on the immersive theater movie “Earth’s Wild Ride” coupled with a teacher-led Power Point lesson. The participants in the study were students in a sixth grade physical science class. The order of lessons showed no detectable effect on final learner outcomes. Based on pre- and post-testing, improvement in mean learning gain came from the teacher-led lesson independent of the movie. The visit to the immersive theater, however, had significant positive effects that did not show up in the quantitative results of the testing.

1 This work is supported in part by Louisiana Board of Regents Grant LEQSF(2008-10)-ENH-TR-05 and NSF grant 0928847.

4:33PM JC.00005 Einstein in Hollywood: Capturing the Scientific Minds of Movie Buffs CHADWICK YOUNG, Nicholls State University — The film industry captures the minds of most students today. Americans spend one-half of their leisure time watching television, and students may often neglect their studies to catch the latest episode of Desperate Housewives or the new release of Leatherheads. Science teachers are challenged to compete with these seemingly unconquerable forces. One alternative to battling the influence of multimedia in its onslaught against the scientific minds of our youth is to embrace these monsters and tame them. By relating what the students know best (who kissed who in Walk the Line) with what they know least (thermodynamics, e.g.), teachers form connections in the minds of their students that will last for many years. In this session, the presenter will demonstrate an inquiry-based method employing clips from popular movies to learn physics. He will show movie clips from several different areas of physics, examine the particular clips in light of those physical principles, and discuss how to use the clips in the classroom.

4:45PM JC.00006 Messages about the Messengers: Reception and Review of “Astronomy’s New Messengers,” The Laser Interferometer Gravitational-wave Observatory’s Interactive Public Exhibition1, BROOKE RANKINS, MARCO CAVAGLIÀ, University of Mississippi, LIGO -EPO TEAM — The Laser Interferometer Gravitational-wave Observatory (LIGO) is an endeavor to directly confirm the existence of gravitational waves, funded by the National Science Foundation. As a publicly funded research project, it is both within its directive and within its best interest to educate and inform the public at large of its efforts. The Education and Public Outreach (EPO) group within LIGO, under the direction of Marco Cavaglia, has developed an interactive exhibit to educate, explain and showcase LIGO to the general public. The exhibit, entitled “Astronomy’s New Messengers,” debuted at the World Science Festival in New York City, and includes features to explain gravitational waves and their possible sources, an interferometer, the space-time fabric model, and the difficulties in identifying a gravitational wave. The exhibit visitors were asked to complete a survey about their experience at “Astronomy’s New Messengers,” and the presentation will report the survey results, and explore the full exhibit’s reception by the general public.

1 This material is based upon work supported, in part, by the National Science Foundation under Grant PHY-0852870.
3:45PM JD.00001 Study of W boson production using the ATLAS detector, WILL HUNTER JOSHUA LOYAL, ZONGJIN QIAN, Duke University, ATLAS COLLABORATION — The Large Hadron Collider is now in operation and providing 7 TeV proton-proton collisions for physics measurements. These data are being used by the ATLAS Collaboration to establish the detector’s performance and to provide tests of the Standard Model in a new energy domain. We will present studies of $pp \rightarrow W + X \rightarrow \ell\nu + X$ production. Events are selected where the $W$ decays to an electron or muon and missing energy as a signal for neutrinos. Methods for selecting these events will be discussed along with the results of early measurements.

3:57PM JD.00002 Study of Z boson production using the ATLAS detector, WILL DICLEMENTE, JIM MALLERNEE, TONEY THOMPSON, Duke University, ATLAS COLLABORATION — The ATLAS detector is recording data from 7 TeV proton-proton collisions provided by the CERN Large Hadron Collider. These data are being used to evaluate the ATLAS detector’s performance using high energy electrons, muons and jets. The measurements provide tests of the Standard Model in a new energy domain. We will present studies of $pp \rightarrow Z + X \rightarrow \ell\ell + X$ production. Events are selected where the $Z$ boson decays to electron or muon pairs. Methods for selecting these events will be discussed along with the results of early measurements of the $Z$ boson’s production properties.

4:09PM JD.00003 Discovering Black Holes Using Top Quarks at ATLAS, TRAVIS BYINGTON, Duke University — The ATLAS detector at the Large Hadron Collider can identify top quarks, which might be produced by non-Standard Model processes such as black hole decays. We explore simulations of black hole production in 7 TeV proton collisions when a top quark is produced in the black hole decay. In this talk, I will discuss prospects for discovering black holes at the LHC using top quark final states.

4:21PM JD.00004 Prospects for Black Hole discovery at ATLAS in the Graviton + X Final State, LAURA DODD, Duke University — The ATLAS detector is a general purpose experiment currently recording 7 TeV proton collisions at the Large Hadron Collider (LHC). Some theoretical models predict that LHC collisions can produce microscopic black holes which would decay into gravitons and other particles. We have simulated $p + p$ production of black holes with different model parameters, and investigated the experiment’s sensitivity to black hole decays with a graviton in the final state. In this talk, I will discuss studies to optimize the black hole signal significance.

4:33PM JD.00005 Search for non-Standard Model CP-odd Higgs Boson, ROMULUS GODANG, University of South Alabama — We search for a new light non-Standard Model CP-odd Higgs boson, $A_0$, using a data sample of Upsilon(1S), Upsilon(2S), and Upsilon(3S) collected by the BABAR detector at the SLAC PEP-II B-factory. We measure a model independent measurement of the branching fraction of Upsilon(4S) decays to $B_0$ and anti-$B_0$ pair. The $B$ mesons are reconstructed in the channel anti-$B_0$ decays to $D^*+_{sea}$ anti-neutrino using a partial reconstruction method. Our result does not depend on any branching fractions, the simulated reconstruction efficiency, the ratio of the charged and neutral $B$-meson lifetimes, or assumption of isospin symmetry. This measurement is important for normalizing many $B$-decay branching fractions.

4:45PM JD.00006 Measurement of the Branching Fraction of $B_0\rightarrow D^{*+}_{sea}$ Lepton Neutrino, CHRISTOPHER BUCHANAN, SHANNON EYNON, ROMULUS GODANG, University of South Alabama — We present a measurement of the branching fraction of semileptonic anti-$B_0$ meson decays to $D^{*+}_{sea}$, lepton, and anti-neutrino using 476 million $B$-meson anti-$B$-meson pairs. The data sample collected with the BABAR detector at the PEP-II asymmetric-energy B-Facotry at SLAC National Accelerator Laboratory. The anti-$B_0$ mesons are reconstructed using a novel technique, partial reconstruction, where the $D_0$ mesons are not reconstructed. The $D^{*+}_{sea}$ mesons are detected only through the soft pion daughter from the decay $D^{*+}$ to $D_0$ pion. We use a single and double tag method to measure the semileptonic branching fraction. This precise measurement plays a prominent role in high energy physics particularly in heavy flavor physics.

4:57PM JD.00007 Measurement of the Branching Fraction of Y(4S) to $B_0$-$B_0\bar{\text{b}}$, SHANNON EYNON, CHRISTOPHER BUCHANAN, ROMULUS GODANG, University of South Alabama — Based on a data sample of 476 million $B$-meson anti-$B$-meson pairs collected at the Upsilon(4S) resonance with the BABAR detector at the PEP-II asymmetric-energy B-Facotry at SLAC, we measure a model independent measurement of the branching fraction of Upsilon(4S) decays to $B_0$ and anti-$B_0$ pair. The $B$ mesons are reconstructed in the channel anti-$B_0$ decays to $D^{*+}_{sea}$ lepton anti-neutrino using a partial reconstruction method. Our result does not depend on any branching fractions, the simulated reconstruction efficiency, the ratio of the charged and neutral $B$-meson lifetimes, or assumption of isospin symmetry. This measurement is important for normalizing many $B$-decay branching fractions.

5:09PM JD.00008 Recent Status of the T2K Experiment, THOMAS KUTTER, LSU, T2K COLLABORATION — The T2K (Tokai to Kamioka) long baseline neutrino oscillation experiment has been constructed to search for the appearance of electron neutrinos in a pure beam of muon neutrinos, thereby measuring $\theta_{13}$, the last unknown mixing angle in the lepton sector. T2K physics goals also include precision measurements of muon neutrino disappearance and the measurements of neutrino interactions at neutrino energies of $\sim 1$GeV. The first physics data were collected from January to June 2010 and data analysis is in progress. I will review the physics reach of T2K, provide an overview of the experimental setup and present the performance of the accelerator produced neutrino beam as well as the near and far detectors. The presentation will conclude with a description of the analysis strategy and recent progress.
force window. This study could possibly lead us to design of quantum levitation system, frictionless bio-fluid transport devices, etc.

materials. The parametric space in terms of the plate’s magnetic and dielectric plasma frequencies, gap thickness and temperature is investigated. The parametric constraints when using naturally available materials in designing the system with air as an intermediate medium is resolved by using artificial electromagnetic

DENTCHO GENOV, Louisiana Tech University — A promising system design aiming to demonstrate Casimir-Polder force (CPF) reversal is proposed. The

measurements of top quark production, electroweak and QCD physics, and also on the dimuon charge asymmetry.

energy of 1.96 TeV. This presentation gives an overview on recent D0 results, including searches for the Higgs particle and for New Physics Phenomena,

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and describe the prospects for discoveries in this context.

parameters, ATLAS will also perform a broad array of searches for inconsistencies between data and theoretical calculations. Recent ATLAS measurements of

Standard Model, a theory that can now be tested in regimes never before explored by experiments. While producing new measurements of Standard Model

the most minute details of proton-proton collision events produced by the Large Hadron Collider. Events are analyzed and compared to the predictions of the

measurements from CDF and D0 and with some of the QCD Monte-Carlo model predictions. In addition, the relationship between the modeling of the

underlying event" in a hard scattering process and the modeling of the complete inelastic non-diffractive cross section will be examined and some of the new

measurements with cosmic ray muons for calibration, and identifies backgrounds. We present work on all the uses of the SMRD: (1) the general role of the SMRD in T2K analyses, (2) status of data quality considerations and data selection performance, (3) SMRD performance measurement with cosmic ray data and comparison with simulations, (4) extraction of neutrino cross-sections on Fe and comparison with simulations.

Friday, October 22, 2010 7:30PM - 9:00PM –
Session LA Banquet Lod Cook Alumni Center, LSU campus

7:30PM LA.00001 DINNER –

8:30PM LA.00002 Spectra goes to Comic-Con: APS Reaching Out

Saturday, October 23, 2010 8:30AM - 10:30AM –
Session MA Into the Unknown: Toward Physics Beyond the Standard Model Nicholson Hall 119

8:30AM MA.00001 What We Have Learned from the Early LHC Measurements, RICHARD (RICK) FIELD, University of Florida — The LHC “underlying event” measurements at 900 GeV and 7 TeV are compared with the Tevatron “underlying event” measurements from CDF and D0 and with some of the QCD Monte-Carlo model predictions. In addition, the relationship between the modeling of the “underlying event” in a hard scattering process and the modeling of the complete inelastic non-diffractive cross section will be examined and some of the new PYTHIA 6.2, PYTHIA 6.4, and PYTHIA 8 tunes which are designed to improve the agreement with the LHC data will be compared and discussed. We have learned a lot about QCD from the early LHC measurements.

9:00AM MA.00002 First Physics Results from CMS, TODD ADAMS, Florida State University — The CMS experiment at the Large Hadron Collider (LHC) has collected and analyzed since spring 2010 at a center of mass energy of 7 TeV. In addition to measurements of well established standard model processes, first results of searches for new physics in this energy regime have been carried out. This talk will concentrate on these searches while also including projections of future results with larger datasets.

9:30AM MA.00003 ATLAS: results and prospects, AYANA ARCE, Duke University — The ATLAS experiment records the most minute details of proton-proton collision events produced by the Large Hadron Collider. Events are analyzed and compared to the predictions of the Standard Model, a theory that can now be tested in regimes never before explored by experiments. While producing new measurements of Standard Model parameters, ATLAS will also perform a broad array of searches for inconsistencies between data and theoretical calculations. Recent ATLAS measurements of QCD and electroweak processes provide the foundation for these ongoing searches for new interactions, and some searches are now establishing new limits. In this talk I discuss the latest measurements from the ATLAS experiment and the performance of the detector systems during the ongoing 7 TeV collider run, and describe the prospects for discoveries in this context.

10:00AM MA.00004 Results from the D0 experiment, MARKUS WOBISCH, Louisiana Tech University — As of summer 2010, the D0 experiment at the Fermilab Tevatron Collider has acquired an integrated luminosity of 8 fb$^{-1}$ in proton-antiproton collisions at a center-of-mass energy of 1.96 TeV. This presentation gives an overview on recent D0 results, including searches for the Higgs particle and for New Physics Phenomena, measurements of top quark production, electroweak and QCD physics, and also on the dimuon charge asymmetry.

Saturday, October 23, 2010 8:30AM - 9:42AM –
Session MB Condensed Matter Physics Nicholson Hall 109

8:30AM MB.00001 Casimir-Polder Force Reversal with Metamaterials, VENKATESH PAPPAKRISHNAN, DENTCHO GENOV, Louisiana Tech University — A promising system design aiming to demonstrate Casimir-Polder force (CPF) reversal is proposed. The constraints when using naturally available materials in designing the system with air as an intermediate medium is resolved by using artificial electromagnetic materials. The parametric space in terms of the plate’s magnetic and dielectric plasma frequencies, gap thickness and temperature is investigated. The parametric domain for achieving CPF reversal is obtained. Furthermore, a simple analytical expression for the CPF is derived. The analytical expression accurately describes the large and short distance asymptotics and allows extraction of important parameters such as lower and upper cutoff gap distances that define the repulsive force window. This study could possibly lead us to design of quantum levitation system, frictionless bio-fluid transport devices, etc.
8:42AM MB.00002 Generic Design of an Invisibility Device¹, PATTABHIRAJU MUNDRI, DENTCHO GENOV, Louisiana Tech University — A generic cloaking design based on realistic optical materials and existing nano-deposition techniques is proposed. A complete suppression of dipolar scattering is demonstrated by engineering cloaking systems encompassing two concentric shells. A transparency condition that does not depend on the object’s geometrical and/or material properties using an expanded parametric space is proposed. The complete elimination of the system extinction cross-section is demonstrated in the quasi-static and full wave regime through use of non-dispersive and non-dissipative materials. Furthermore, a realistic shell designs based on composite metal/dielectric media is studied and the effect of loss and dispersion on the overall scattering cross-section is evaluated. It is shown that substantial reduction in the extinction cross-section (up to a factor of $10^3$) can be achieved with pure dielectric materials in the optical and near-infrared spectral ranges. This study may provide a new direction for achieving optical invisibility without involvement of magnetism, i.e. metamaterials.

¹Louisiana Board of Regents under contract number LEQSF (2007-12)-ENH-PKSF-PRS-01.

8:54AM MB.00003 MEAM potential for Al, Si, Mg, Cu, and Fe alloys, BOHUMIR JELINEK, JEFF HOUZE, Mississippi State University, SEBASTIEN GROH, TU Bergakademie Freiberg, SEONG-GON KIM, MARK F. HORSTEMEYER, Mississippi State University, GREGORY WAGNER, Sandia National Laboratories, MICHAEL BASKES, University of California in San Diego — Modified Embedded Atom Method (MEAM) potential for Al, Si, Mg, Cu, and Fe alloys was developed as a combination of existing MEAM potentials for single elements. Pair parameters were constructed based on the structural and elastic properties of element pairs in the NaCl reference structure from ab-initio simulations, and then adjusted to reproduce heats of formation for binary compounds and defect formation energies. Some of the single element MEAM parameters were also improved to better match the generalized stacking fault curve. Validity and transferability of the new MEAM potential was tested by comparison with ab-initio simulations and experiments when available.

9:06AM MB.00004 Fermi-liquid properties of strongly imbalanced Fermi gases, KELLY PATTON, DANIEL SHEEHY, Louisiana State University — Recent experiments [Schiotzet et al., PRL 102, 230402 (2009)] involving highly imbalanced ultracold atomic gases have revealed so-called spin or Fermi polarons. These quasiparticles are composed of spinful atoms correlated with a “cloud” of atoms of opposite spin. These correlations lead to a renormalization of the free or bare atom’s properties. Theoretically, these quasiparticles have been well described by a variational wave function consisting of a single impurity atom interacting with the remaining Fermi sea. Using diagrammatic many-body theory we extend these results and investigate the dependence of the polaron’s Fermi liquid properties on finite temperature, as well as increased polaron density. Furthermore, we investigate instabilities of this normal Fermi liquid state, such as transitions to a superfluid or phase-separated state, as the temperature is lowered and/or the density of polarons is increased.

9:18AM MB.00005 Cyclotron Resonance in a High Mobility 2DEG¹, JEREMY CURTIS, JON MOORE, University of Alabama at Birmingham, TAKAHISA TOKUMOTO, National High Magnetic Field Lab, JUDY CHERIAN, Florida State University, NATHAN RIDLING, University of Alabama at Birmingham, XIANG FENG WANG, Rice University, JOHN RENO, Sandia National Lab, ALEXEY BELYANIN, Texas A&M University, JUNICHIRO KONO, Rice University, STEPHEN MCGILL, National High Magnetic Field Lab, DAVID HILTON, University of Alabama at Birmingham — We have systematically studied the cyclotron resonance lifetimes of a high mobility ($\mu = 3.4 \times 10^6 \text{cm}^2 \text{V}^{-1} \text{s}^{-1}$) two-dimensional electron gas as a function of temperature (0.38 K-80 K) using ultrafast terahertz spectroscopy. The cyclotron lifetime increases by ~2x from 1.2 to 0.38 K, which results in a concomitant decrease in transmission amplitude due to the saturation effect. The differential amplitude of the time-delayed secondary pulse field is larger than the primary pulse and is not consistent with a Drude free carrier model.

¹We acknowledge support from Department of Education Grant No. P200A090143.

9:30AM MB.00006 Electro-Optic Surface Effects in Rubidium Titanyl Phosphate (RTP). CHRISTOPHER L. MUELLER, DANIEL AMARUTEI, MUZAMIL ARAIN, GUIDO MUELLER, DAVID REITZE, DAVID TANNERR, University of Florida, LIGO COLLABORATION — The Laser Interferometer Gravitational Wave Observatory (LIGO) is a ground based gravitational wave telescope which utilizes a Michelson interferometer design to detect the differential changes in length caused by passing gravitational waves. Multiple resonant cavities were added to the interferometer design in order to increase power circulating in the interferometer, and thereby decrease noise. Resonant cavities, however, are very sensitive to alignment and hence can introduce a new source of noise into the interferometer output channel. As a risk reduction experiment, we developed an active cavity alignment system using textbook electro-optic RTP prisms which should theoretically be able to suppress noise into the high MHz regime. During initial testing of the prisms it was discovered that both the amount and direction of the deflection induced by an applied electric field vary strongly over the surface of the prism. This talk will describe the subsequent investigations into the nature of these inhomogeneities.

Saturday, October 23, 2010 10:45AM - 12:45PM — Session NA Fundamental Physics at the Oak Ridge Spallation Neutron Source — Nicholson Hall 119

10:45AM NA.00001 The neutron EDM experiment at the SNS, CHRISTOPHER CRAWFORD, University of Kentucky — A non-zero neutron electric dipole moment (EDM) would violate both parity and time reversal symmetry and measurement of this quantity will help to understand the source of baryon asymmetry in the universe. An effort is underway at the Spallation Neutron Source at Oak Ridge National Laboratory to measure the neutron EDM by detecting a modulation in the neutron spin precession frequency correlated with reversal of a strong electric field. In this experiment, ultra-cold neutrons are produced in liquid helium where the EDM is measured in situ. A trace amount of $^3$He is used as a co-magnetometer and as a detector of the neutron spin precession. Experimental details and projected results will be presented.

11:15AM NA.00002 Precision measurements in free neutron beta decay, STEFAN BAESSLER, University of Virginia — The study of neutron beta decay serves to determine the coupling constants of beta decay and allows several precision tests of the Standard Model of Elementary Particle Physics at low energies. For this purpose, the neutron lifetime, and correlations between the momenta and spins of the particles involved are measured. In my talk, I will discuss present experiments, with the emphasis of the neutron beta decay program planned for the fundamental physics beamline at the SNS.
11:45AM NA.00003 Hadronic parity-violation in pionless effective field theory\textsuperscript{1} - MATTHIAS R. SCHINDLER, The George Washington University — At low energies, the weak interactions between quarks manifest themselves in a parity-violating component of the interactions between nucleons. Experiments are being performed at the SNS, NIST and other neutron facilities to map out this weak component of the nuclear force. I will describe how effective field theory is used to describe hadronic parity violation in a systematic and model-independent way. After discussing two-nucleon observables, such as the photon asymmetry $\Lambda_{\gamma}$ in polarized neutron capture $np \to d\gamma$, I will focus on the three-nucleon system. It is shown that parity-violating three-nucleon interactions do not contribute at the accuracy of current and prospective experiments. Therefore, two-nucleon experiments can be used to gain information on parity-violating two-nucleon interactions. I will also present the results of an effective field theory calculation of neutron spin rotation in deuterium.

\textsuperscript{1}Supported by NSF Career award PHY-0645498 and DOE grant DE-FG02-95ER-40907.

12:15PM NA.00004 Physics with Spallation Neutron Source Neutrinos - KATE SCHOLBERG, Duke University — Copious neutrinos with energies of a few tens of MeV are produced at the SNS as a free by-product. This neutrino source is ideal for various neutrino experiments. I will describe the properties of such stopped-pion-beam sources of neutrinos, and will discuss the potential for measurements of neutrino cross-sections of astrophysical relevance, Standard Model tests, and neutrino oscillation physics.

Saturday, October 23, 2010 10:45AM - 12:21PM – Session NB Superconductivity Nicholson Hall 109

10:45AM NB.00001 Synthesis and Physical Properties of BaCo2As2 Single Crystals - AMAR KARKI, YIMIN XIONG, RONGYING JIN, Louisiana State University — We report synthesis and physical properties of BaCo2As2 single crystals grown by the self-flux method. While it does not show any magnetic and structural transition, the results reveal that BaCo2As2 is a usual paramagnetic metal with Wilson ratio well exceeding unity. We will discuss the implication by comparing its electrical, magnetic and thermodynamic properties with those of BaFe2As2.

10:57AM NB.00002 BaFe2As2 Surface Domains and Domain Walls: Mirroring the Bulk Spin Structure - GUORONG LI, XIAOBO HE, Louisiana State University, LA; ANG LI, University of Houston, Houston, TX, SHUHENG PAN, University of Houston, TX, JIANDI ZHANG, RONGYING JIN, Louisiana State University, LA, ATHENA S. SEFAT, MICHAEL A. MCGUIRE, Oak Ridge National Laboratory, TN, DAVID G. MANDRUS, Oak Ridge National Laboratory and The University of Tennessee, TN, BRAIN C. SALES, Oak Ridge National Laboratory, TN, WARD PLUMMER, Louisiana State University, LA — We have used scanning tunneling microscopy/spectroscopy (STM/STS) to investigate the geometric and electronic structure at the (001) surface of the parent compound BaFe2As2. While high-resolution STM measurements reveal a (1x1) As-terminated unit cell on the (001) surface, there are significant differences of the surface unit cell compared to the bulk: only one of the two As atoms in the unit cell is imaged and domain walls between different (1x1) regions display a C2 symmetry at the surface. It should have been C2v if the STM image reflected the geometric structure of the surface or the orthorhombic bulk. The inequivalent As atoms and the bias dependence of the domain walls indicate that the origin of the STM image is primarily electronic not geometric. We argue that the surface electronic topography mirrors the bulk spin structure of BaFe2As2, via strong orbital-spin coupling.

11:09AM NB.00003 High-Temperature Electrical and Magnetic Properties of Undoped Iron Pnictides - JIANNENG LI, Louisiana State University, Y. XIONG, Y. YANG, R. JIN, LSU, T. QI, G. CAO, UK, J.R. THOMPSON, ORNL/UT, W. HANG, B.C. SALES, A.S. SEFAT, M.A. MCGUIRE, ORNL, V. KEPPENS, UT, D. MANDRUS, ORNL — We have investigated the electrical and magnetic properties of several parent compounds of Fe-based superconductors in a wide temperature range. In addition to the well-known transitions (one structural transition at T_B.C. SALES, A.S. SEFAT, M.A. MCGUIRE, ORNL, V. KEPPENS, UT, D. MANDRUS, ORNL — We have investigated the electrical and magnetic properties

11:21AM NB.00004 Unusual Temperature and Field Dependence of Transport Properties Ba(Fe1-xCox)2As2 - YIMIN XIONG, JIANNENG LI, RONGYING JIN, Department of Physics and Astronomy, Louisiana State University — The in-plane transport properties of Ba(Fe1-xCox)2As2 single crystals with $x = 0.02 \sim 0.28$ was measured as a function of temperature ($2 \sim 300$ K) and magnetic field (up to 14 Tesla). A Cobalt doping composition-temperature-$(x$-$T)$ phase diagram was plotted and shows a non-Fermi liquid (NFL) transport behavior around the optimal doping level. The Hall effect and magneto-resistance results also show an anomaly and a change of field dependence around the optimal doping. The underlying physics of such unusual temperature and field dependence of transport properties ab plane will be discussed.

11:33AM NB.00005 Possible free flux flow phase in single crystals of optimally doped Ba(Fe1-xCox)2As2\textsuperscript{1} - A.A. GAPUD, O. GAFAROV, University of South Alabama, D.K. CHRISTEN, Oak Ridge National Laboratory, J.R. THOMPSON, University of Tennessee and Oak Ridge National Laboratory — The possibility of a new magnetic component to the superconductivity in the recently discovered iron-containing superconductors — something previously deemed impossible — has attracted a wide breadth of studies. One area of interest is in magnetic phase transitions in the mixed-state "flux medium" comprised of interacting magnetic flux quanta (or vortices) which are found in Type II superconductors. Not surprisingly, the flux dynamics in these materials already show novelties not yet completely understood. Recent work from various groups do agree on a vortex "liquid" phase at highest fields and temperatures, with a "melting" transition line from a phase in which interactions between vortices become significant — all while still affected by pinning mechanisms. To test the proposed phases, the present study explores the possibility of achieving the highly ordered free flux flow (FFF) phase in optimally doped Ba(Fe1−0.9xCo0.0x)2As2. This may well be the first time such a measurement is reported for iron arsenides, which are also known for strong pinning. Results and preliminary analyses are discussed.

\textsuperscript{1}Research funded by an NSF-RUI grant.
11:45AM NB.00006 Free flux flow in two single crystals of V$_3$Si with slightly different pinning strengths$^1$. O. GAFAROV, A.A. GAPUD, S. MORAES, University of South Alabama, J.R. THOMPSON, University of Tennessee and Oak Ridge National Laboratory, D.K. CHRISTEN, Oak Ridge National Laboratory, A.P. REYES, National High Magnetic Field Laboratory — Results of recent measurements on two very clean, single-crystal samples of the A15 superconductor V$_3$Si are presented. Magnetization and transport data already confirmed the “clean” quality of both samples, as manifested by: (i) high residual resistivity ratio, (ii) very low critical current densities, and (iii) a “peak” effect in the field dependence of critical current. The (H,T) phase line for this peak effect is shifted in the slightly “dirtier” sample, which consequently also has higher critical current density $J_c(H)$. High-current Lorentz forces are applied on mixed-state vortices in order to induce the highly ordered free flux flow (FFF) phase, using the same methods as in previous work. A traditional model by Bardeen and Stephen (BS) predicts a simple field dependence of flux flow resistivity $\rho_f(H)$, presuming a field-independent flux core size. A model by Kogan and Zelezhina (KZ) takes core size into account, and predict a clear deviation from BS. In this study, $\rho_f(H)$ is confirmed to be consistent with predictions of KZ, as will be discussed.

$^1$This research was funded by the Research Corporation and by an NSF-RUI grant.

11:57AM NB.00007 Deviation in magnetoresistive Kohler’s rule due to Martensitic transformation in V$_3$Si$^1$, S. MORAES, O. GAFAROV, A.A. GAPUD, University of South Alabama, J.R. THOMPSON, University of Tennessee and Oak Ridge National Laboratory, D.K. CHRISTEN, Oak Ridge National Laboratory, A.P. REYES, National High Magnetic Field Laboratory — Preliminary results are presented on a comparison between two very clean, single-crystal samples of the A15 superconductor V$_3$Si. Three independent measurements on the same samples—namely: (i) resistivity versus temperature, (ii) magnetic susceptibility, and (iii) nuclear magnetic resonance—confirm that (a) both samples have a high residual resistivity ratio and (b) the Martensitic transformation is manifest in one sample, but suppressed in the other. This provides the opportunity to study how the Martensitic transformation causes the magnetoresistivity of V$_3$Si to deviate from Kohler’s Rule, adding more detailed information to results obtained previously. Results and analysis are discussed.

$^1$This research was funded by the Research Corporation and by an NSF-RUI grant.

12:09PM NB.00008 Inductive Critical Currents in Mo/Nb layered structures$^1$. PHILLIP BROUSSARD, DAVID MYERS, JAMES VELDHORST, Covenant College — We have carried out measurements of inductive critical currents in Mo/Nb layered films. The films were grown by magnetron sputtering onto silicon substrates from separate sources. We grew films with the structure (N/S)$^m$, where the Mo/Nb bilayer is repeated $m$ times. Here the base bilayer unit is composed of a Mo layer 36.9 nm thick and a Nb layer 43.2 nm thick, while $m$ varies from 1 to 4. The films grow with (110) orientation, as expected for bcc materials. Inductive critical currents were measured using a third harmonic technique, while superconducting transition temperatures ($T_c$) were measured both resistively and inductively. The films were cooled by a cryocooler down to temperatures of approximately 6 K. We find the $T_c$ and the critical current density ($J_c$) are nearly independent of $m$. $J_c$ varies as $(1-t)^{3/2}$ as expected from Ginzburg-Landau theory (here $t$ is the reduced temperature, $T/T_c$). Measurements of $J_c$ have also been made in low magnetic fields, and will be discussed.

$^1$Supported by NSF under grant DMR-0820025.