2011 Annual Meeting of the California-Nevada Section of the APS
Menlo Park, California
http://www.aps.org/meetings/meeting.cfm?name=CAL11
Friday, November 11, 2011 10:00AM - 11:12AM –
Session A1 Plenary I Panofsky Auditorium - Lynn Cominsky, Sonoma State University

10:00AM A1.00001 The Fermi Gamma-ray Space Telescope at Three Years STEVE RITZ, UC Santa Cruz — .

10:36AM A1.00002 Catching Shadows: Kepler’s Search for Terrestrial Planets, NATALIE BATALHA, San Jose State University —

Friday, November 11, 2011 11:30AM - 11:50AM –
Session A2 California-Nevada Section Business Meeting Panofsky Auditorium -

Friday, November 11, 2011 1:30PM - 3:30PM –
Session B1 AMO & Plasma Physics Bldg 48 - ROB Redwood A/B - Peter Beiersdorfer, Lawrence Livermore National Laboratory

1:30PM B1.00001 Spectroscopic Measurements of Photo Pumped Highly Charged Ions, A. GRAF, P. BEIERSDORFER, G.V. BROWN, LLNL, J.R. CRESPO LOPEZ URRUTIA, MPIK, HI-LIGHT EBIT TEAM — We report on recent x-ray laser spectroscopic measurements of line emission from photo-excited highly charged ions. The ion cloud of the HI-LIGHT portable electron beam ion trap (EBIT) was used as a target for the Linac Coherent Light Source (LCLS) free electron laser in the Soft X-Ray (SXR) end station. The SXR monochromator allowed a precision investigation of transition energies and oscillator strength ratios of emission lines from Na-like Fe$^{15+}$ and Ne-like Fe$^{16+}$ important for astrophysical diagnostics. We have demonstrated a technique for calibration of the SXR monochromator photon energy scale using photo-excited resonant fluorescence spectra of very well known lines from H-like and He-like F and O. Numerous instruments were used to diagnose the fluorescent and autoionizing decay channels of the trapped plasma including an Iglet-X broadband germanium detector, a variable line spacing reflection grating soft x-ray/VUV spectrometer and a Wien filter based ion extraction system. An overview of the experiment as well as preliminary results will be presented.

1 Portions of this research were carried out at the Linac Coherent Light Source (LCLS) at the SLAC National Accelerator Laboratory. LCLS is an Office of Science user facility operated for the U.S. DoE Office of Science by Stanford University.

1:42PM B1.00002 Size dependent ionization dynamics of argon clusters in intense x-ray pulses, SEBASTIAN SCHORB, M. SWIGGERS, SLAC National Accelerator Laboratory, D. RUPP, Technische Universität Berlin, R. COFFEE, M. MESSERSCHMIDT, S. MÖLLER, G. WILLIAMS, J. BOZEK, SLAC National Accelerator Laboratory, T. OSIPOV, Western Michigan University, S. WADA, Hiroshima University, O. KORNILOV, Max Born Institut, T. MÖLLER, Technische Universität Berlin, C. BOSTEDT, SLAC National Accelerator Laboratory — Free Electron Lasers open the door for novel experiments in many science areas ranging from ultrafast chemical dynamics to single shot imaging of molecules. For the success of virtually all experiments with free electron lasers a detailed understanding of the light - matter interaction in the x-ray regime is pivotal. The Linac Coherent Light Source (LCLS) free electron laser in Stanford allows for the first time to study inner shell ionization dynamics of intense x-ray pulses on a femtosecond time scale. We performed experiments on the ionization dynamics of Argon clusters at different pulse length using the slotted spoiler foil in the second LCLS bunch compressor [1]. The Auger rate of argon clusters is predicted to be size dependent and lower than in atoms due to delocalization of the valence electrons [2]. We observe a dependence of the ionization dynamics on pulse length and cluster size. The results are discussed and also compared to recent atomic and molecular data from LCLS.


1:54PM B1.00003 High-Energy Neutron Source For Fusion Material Property Studies Using Short Pulse Lasers, D.P. HIGGINSON, J.M. MCNANEY, D.C. SWIFT, D. BLEUEL, A.J. MACKINNON, P.K. PATEL, LLNL, G.M. PETROV, J. DAVIS, NRL, V. YU GLEBOV, C. STOECKL, LLE, J. COBBLE, LANL, J.A. FRENJE, MIT, R. KODAMA, H. NAKAMURA, ILE, K.L. LANCASTER, RAL, L.C. JARROTT, F. N. BEG, UCSD — High-energy (>10 MeV) neutron generation is of interest to applications including fusion energy, material damage studies and nondestructive material detection. A novel technique to create high-energy neutrons was demonstrated using short pulse (10 ps), high-energy (350-1000 J) lasers at the Titan and Omega EP laser systems. In this method, the laser accelerates deuterons from a CD foil, which produce neutrons as they pass through a LiF block via the reaction $^7$Li(d,xn), $Q=15\text{ MeV}$. The spectrum is forward peaked in both energy and number. The presence of proton contaminants on the CD foil dramatically inhibits the acceleration of deuterons, which reduces the neutron generation. Activation diagnostics and CR39 detectors recorded single shot neutron fluences of up to $3 \times 10^{13} \text{ n cm}^{-2}$ at 15 MeV in the forward direction. Methods to improve neutron yield and directionality will be presented.

1This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory DE-AC52- 07NA27344.
2:06PM B1.00004 Visible Spectroscopy on the Plasma Liner Experiment (PLX)¹. JACOB SCHWARTZ, UCLA, TOM AWE, SCOTT HSU, LANL, ELIZABETH MERRITT, ALANLYNN, MARK GILMORE, UNM, STEPHAN FUELLING, UNR — The Plasma Liner Experiment (PLX) will study the merging of thirty high Mach number jets of argon plasma in a spherically convergent configuration. Initial experiments will study single jet propagation, where it is important to measure the jet density, velocity, and temperature to evaluate jet evolution during its transit from the chamber wall toward the center. We have constructed a broad band visible light survey spectrometer to observe light emitted from the plasma jet in order to identify the best specific argon emission lines on which to perform Doppler and Stark broadening analysis. Special attention has been paid to maximize throughput because of low expected light levels. Light is collected by a lens coupled to a hexagonal bundle of seven 1 mm core diameter fibers. The fibers fan out to couple to the slit of a 14 cm focal length spectrometer which is observed by an intensified CCD camera. We discuss the design and assembly of this spectrometer system and (time permitting) initial data from single jet experiments. This work will inform the design of a high resolution spectroscopy system for future PLX experiments. 

¹Supported by the DOE NUF Program and OFES.

2:18PM B1.00005 FTIR Spectroscopy and Density Functional Theory of the 1474 cm⁻¹ Absorption in C₉, Carbon Cluster Spectra². MEKENA MCGREW, St. Mary’s College of California, CHRISTINA LE, W.R.M GRAHAM, Texas Christian University, TEXAS CHRISTIAN UNIIVERSITY MOLECULAR PHYSICS LAB TEAM — The identification of the infrared frequencies of carbon clusters is significant for astrophysical and material science research. By using FTIR spectroscopy, density functional theory, and argon matrix trapping numerous C₉, carbon clusters have been observed in the Nd:YAG laser ablation products trapped in solid argon. An unidentified absorption at 1474 cm⁻¹ has been observed in our experiments, and ¹³C isotopic shift measurements and DFT calculations have been performed to test potential C₉ candidates for the carrier of the band. The number and relative intensities of the isotopic shifts suggest a molecule consisting of 4 or 6 atoms. Simulated ¹³C shift spectra have been calculated for a variety of 4- and 6-member C₉, structure using the B3LYP functional and ccPVDZ basis set. Potential sources of the 1473 cm⁻¹ band will be discussed.

²National Science Foundation Grant PHYS-0851558

2:30PM B1.00006 Quantum Transport through Fullerenes, SHAMBHU DAS, PETER WINKLER, University of Nevada, Reno NV 89557 — Quantum transport of electron pathways has recently attracted increased interest in the field of nanotechnology. The study of transport through mesoscopic system can explain a wide range of interesting experimental features such as rectification, switching mechanism and transistor actions. The present study is aimed at the possible use of transmission spectrums to distinguish between various isomers of certain fullerene molecules. While the famous C₆₀ is found as a single isomer, other fullerenes come in different isomeric structures, for example, there are forty distinct isomers known for C₆₀.

2:42PM B1.00007 Direct Frequency Comb Spectroscopy of Alkali Atoms¹. TRINITY PRADHANANGA, CHRISTOPHER PALM, California State University - East Bay, KHOA NGUYEN, San Jose State University, SRIKANTH GUTTIKONDA, DEREK JACKSON KIMBALL, California State University - East Bay — We are using direct frequency comb spectroscopy to study transition frequencies and excited state hyperfine structure in potassium and rubidium using 2-photon transitions excited directly with the frequency-doubled output of an erbium fiber optical frequency comb. The frequency comb output is directed in two counterpropagating directions through a vapor cell containing the atomic vapor of interest. A pair of optical filters is used to select teeth of the comb in order to identify the transition wavelengths. A photomultiplier tube (PMT) measures fluorescence from a decay channel wavelength selected with another optical filter. Using different combinations of filters enables a wide range of transitions to be investigated. By scanning the repetition rate, a Doppler-free spectrum can be obtained enabling kHz-resolution spectral measurements. The thermal motion of the atoms in the vapor cell actually eliminates the need to fine-tune the offset frequency and repetition rate, alleviating a somewhat challenging requirement for spectroscopy of cold atoms. Our investigations are laying the groundwork for a long-term research program to use direct frequency comb spectroscopy to understand the complex spectra of rare-earth atoms. 

¹This work was supported in part by the National Science Foundation under grant PHY-0958749.

2:54PM B1.00008 A test of the (circular) Unruh effect using atoms, DOUGLAS SINGLETON, California State University, Fresno — We propose a test for the (circular) Unruh effect using certain atoms – fluorine and oxygen. For these atoms the centrifugal acceleration of the outer shell electrons implies an effective Unruh temperature in the range 10⁰⁰ – 20⁰⁰ K. This range of Unruh temperatures is large enough to excite a significant fraction of the outer electrons into low lying energy levels above the ground state. Examining these atoms at low ambient temperatures and finding a larger than expected number of electrons in low lying excited states beyond what is expected via background thermal excitation would provide experimental evidence for the Unruh effect.

3:06PM B1.00009 Progress toward a search for spin-mass couplings of the proton¹. JERLYN SWIATLOWSKI, JULIAN VALDEZ, IAN LACEY, CAITLIN MONTCRIEFFE, DEREK JACKSON KIMBALL, California State University - East Bay — We report progress in our development of a dual-isotope rubidium magnetometer to be used to search for a long-range coupling between proton spins and the mass of the Earth. The valence electron dominates magnetic interactions and serves as a precise co-magnetometer for the nuclei in a simultaneous measurement of Rb-85 and Rb-87 spin precession frequencies, enabling accurate subtraction of magnetic perturbations. Both Rb nuclei have valence protons, but in Rb-87 the proton spin is parallel to the nuclear spin and magnetic moment while for Rb-85 the proton spin is anti-parallel to the nuclear spin and magnetic moment. Thus anomalous interactions of the proton spin produce a differential shift between the Rb spin-precession frequencies, whereas many sources of systematic error produce common-mode shifts of the spin-precession frequencies which can be controlled through auxiliary measurements. We discuss our optimization of the magnetometer sensitivity and methods to control systematic effects due to light shifts, collisions, and the gyro-compass effect. 

¹This work was supported in part by the National Science Foundation under grants PHY-0652824 and PHY-0969666.

3:18PM B1.00010 Physics in Screening Environments, ONDREJ CERTIK, PETER WINKLER, University of Nevada, Reno NV 89557 — The calculation of electronic states of atoms in screening environments, e.g. plasmas, is often performed using Debye’s approach which replaces the frequency independent part of screening by a simple, distance dependent function. Only later has this Debye’s approach which replaces the frequency independent part of screening by a simple, distance dependent function. Only later has this
1:30PM B2.00001 Fermi Large Area Telescope Second Source Catalog, SETH DIGEL, KIPAC/SLAC, JEAN BALLET, CEA/Saclay, THOMPSON BURNETT, University of Washington, GINO TOSTI, University of Perugia, FERMI LARGE AREA TELESCOPE COLLABORATION — We present the second catalog of high-energy gamma-ray sources detected by the Large Area Telescope (LAT), the primary science instrument on the Fermi Gamma-ray Space Telescope (Fermi). The Second Fermi LAT catalog (2FGL) is the product of a comprehensive analysis of the first 2 years of LAT science data. The catalog contains 1873 sources detected and characterized in the 100 MeV to 100 GeV range of which we consider 1272 as being firmly identified and 1170 as being reliably associated with counterparts of known or likely gamma-ray-producing source classes. In addition, 576 of the 2FGL sources have no plausible counterparts at other wavelengths. The 2FGL catalog and associated products are available from the Fermi Science Support Center. We look forward to extensive use of this catalog in high-energy astrophysics.

1:42PM B2.00002 Measurement of the cosmic-ray positron spectrum with the Fermi LAT using the Earth’s magnetic field, JUSTIN VANDENBROUCKE, Stanford University and SLAC National Accelerator Laboratory, MARKUS ACKERMAN, DESY Zeuthen, STEFAN FUNK, WARIT MITTHUMSIRI, Stanford University and SLAC National Accelerator Laboratory, CARMELO SGRO, INFN Pisa, FERMI LAT COLLABORATION — In addition to its primary purpose as a gamma-ray telescope, the Fermi Large Area Telescope is an excellent cosmic-ray electron and positron detector and has measured their combined spectrum between 7 GeV and 1 TeV. Although the LAT itself cannot distinguish electrons and positrons, the Earth’s magnetic field creates natural “shadows” from which particular charges are forbidden because their paths are blocked by the Earth. Using a precise model of the geomagnetic field produced by an international collaboration of geophysicists, we trace particle trajectories in order to separate electrons and positrons. We have used this geomagnetic technique for the first time to measure the electron-only spectrum, the positron-only spectrum, and the positron fraction, all between 20 GeV and 200 GeV. We also note the LAT’s capability to identify secondary positrons produced by cosmic ray air showers.

1:54PM B2.00003 Limits on Large Extra Dimensions Based on Observations of Neutron Stars with the Fermi-LAT, BIJAN BERENJI, ELLIOTT BLOOM, SLAC National Accelerator Laboratory/Stanford University/KIPAC, JOHANN COHEN-TANUGI, Laboratoire Univers et Particules de Montpellier, IN2P3 (France), FERMI-LAT COLLABORATION — We present limits for the compactification scale in the theory of Large Extra Dimensions (LED) of Arkani-Hamed, Dimopoulos, and Dvali. We use 11-months of Fermi-LAT data to set γ-ray flux limits for 6 gamma-ray faint neutron stars (NS). To set limits on LED, we use the model of Hannestad and Raffelt (HR) that calculates the Kaluza-Klein graviton ($G_{KK}$) production in supernova cores and the large fraction subsequently gravitationally bound around the resulting NS. The decays $G_{KK} \rightarrow \gamma\gamma$ should contribute to the flux from NSs. For $n = 2, 3, ..., 7$ LED of the same size in the context of the HR model, we use MC techniques to calculate the expected differential flux of gamma-rays arising from these KK gravitons, including the effects of the age of the NS, graviton orbit, and absorption of gamma-rays in the magnetosphere of the NS. We compare our MC differential flux to the experimental differential flux using maximum likelihood techniques, and obtain limits on LED that are more restrictive than past EGRET-based optimistic limits that do not include these important corrections. Additionally, our limits are more stringent than collider limits for 3 or fewer LED. If the Effective Planck scale is around a TeV, then with $n = 2, 3$, the LED topology is non-toroidal.

2:06PM B2.00004 The VERITAS Extragalactic Sky: Contemporaneous Modeling of Very High Energy Blazars with Constraints from Swift, AMY FURNISS, UC Santa Cruz, VERITAS COLLABORATION — In the past decade, remarkable progress has been made in very high energy (VHE; E>100 GeV) gamma-ray astrophysics. The VERITAS source catalog currently contains 48 extragalactic objects. VERITAS has detected 23 of these, including 10 VHE blazar discoveries, and have gone on to detect ~500 VHE blazar candidates which the LAT has observed. VERITAS has performed contemporaneous modeling of the highest energy VHE blazar sources with Swift observations of Swift XRT flaring episodes. VERITAS has detected and modeled the Crab, 3C 279, and PKS 0528+161, among others. VERITAS observations are contempornaneous with Swift observations and have been key to defining the average X-ray flattening phenomenon of the highest energy blazar sources. For PKS 0528+161, VERITAS observations are the closest simultaneous observations of VERITAS and Swift. VERITAS observations that are contemporaneous with Swift observations are presented.

2:18PM B2.00005 VERITAS Investigation of Very High Energy Emission from B2 1215+303, MELINDA SOARES, University of California, Santa Cruz, VERITAS COLLABORATION — The Very Energetic Radiation Imaging Telescope Array System (VERITAS) consists of four 12m imaging atmospheric Cherenkov telescopes, stationed at the Fred Lawrence Whipple Observatory in southern Arizona. The investigation of gamma-ray emission from blazars is one of the VERITAS collaboration’s key science projects. This presentation reports the detection and systematic investigation of very high energy emission from the low-frequency-peakd BL Lacertae object B2 1215+303 located at a redshift of z=0.013. B2 1215+303 was first reported as a VHE source by the MAGIC Telescope Collaboration in early 2011 January during a flare that lasted four nights. The MAGIC Collaboration reported a flux of 2.0% of the Crab above 250 GeV. Based on VERITAS observations performed from 2008 December to 2011 June and augmented with target of opportunity observations from NASA’s Swift satellite at X-ray energies in 2011, flux and spectral variability as well as the X-ray-TeV gamma-ray flux correlation are explored.

2:30PM B2.00006 Coalescing Compact Binaries with Quark Star Component, SAM KOSHY, PRASHANTH JAIKUMAR, California State University, Long Beach, MICHELE VALLISNERI, Jet Propulsion Laboratory — Binary stars in close orbit around each other emit gravitational radiation, which causes their orbit to decay. Here we study the tidal interactions between such inspiraling compact binaries, with neutron star-quark star and black hole-quark star components. While the gravitational radiation waveforms from coalescing binaries can be calculated fairly accurately, tidal torques cause phase errors to accumulate in their gravitational wave signal, which become significant in the event the two stars tidally lock (i.e. their orbital and spin frequencies are synchronized). Given the large viscosity that a quark star can have, tidal synchronization for both types of binaries is shown to be possible; thereby hampering signal extraction if the resulting phase difference is not incorporated into the theoretical waveform templates. In addition, the signal strengths of a gravitational wave signal from such systems are shown. And finally, we consider the possibility of stable mass transfer from the quark star to the neutron star.

1This project is supported by NASA Graduate Student Researchers Program (GSRP) Grant #NNX10AK81H.
Current and Upcoming Sensitivities to Dark Matter in Gamma-Ray Observatories

1:30PM B3.00001 Nuclear spin diffusion in quantum confined semiconductor nanostructures, Daniel Henriksen, Ionel Tifrea, California State University Fullerton — We analyze the nuclear spin diffusion effect in semiconductor quantum wells in connection with dynamical nuclear polarization under optical pumping. The natural confinement provided by the particular geometry of quantum well structures is responsible for a position dependent nuclear spin relaxation time and a reduced nuclear spin diffusion. In particular, we consider the case of GaAs quantum wells within GaAlAs barriers and analyze the nuclear spin diffusion for As nuclei by the particular geometry of quantum well structures is responsible for a position dependent nuclear spin relaxation time and a reduced nuclear spin diffusion. In particular, we consider the case of GaAs quantum wells within GaAlAs barriers and analyze the nuclear spin diffusion for As nuclei.

2:42PM B3.00002 Transient-Grating Study of Electron and Hole Diffusion in (Ga,Mn)As, Eric Kittlaus, Santa Clara University — Dilute magnetic semiconductors are a class of materials exhibiting both semiconducting and ferromagnetic properties while being chemically similar to traditional semiconductors. This dual nature presents the opportunity for new "spintronic" devices, with the caveat that current dilute magnetic semiconductors are only ferromagnetic above their subzero Curie temperature, Tc. In order to develop new materials functional at room temperature, it is necessary to develop a better theoretical understanding of how such materials become magnetic, a result of microscopic electronic processes. One of the most common dilute magnetic semiconductors, (Ga,Mn)As, is produced by doping Gallium Arsenide with manganese. We use a laser-based experiment, transient-grating spectroscopy, to measure the diffusive motion of electrons and holes in (Ga,Mn)As, which provides information related to the processes which control magnetism in these materials. We present preliminary data and calculations and discuss further improvements in experimental design.

1:42PM B3.00003 Spectral and polarization modulation of quantum dot emission in a one-dimensional liquid crystal photonic cavity, Andrea L. Rodarte, C. Gray, L.S. Hirst, S. Ghosh, University of California, Merced — We demonstrate spectral and polarization modulation of chemically synthesized core shell CdSe/ZnS quantum dots (QDs) embedded in a one-dimensional photonic cavity formed by a cholesteric liquid crystal (CLC) matrix. A Cano-wedge cell varies the pitch of the CLC leading to the formation of Grandjean steps. This spatially tunes the photonic stop band, changing the resonance condition and continuously altering both the emission wavelength and polarization state of the QD ensemble. Using high resolution spatially- and spectrally-resolved photoluminescence measurements we find that the emission is elliptically polarized and that the tilt of the ellipse, which means the rate increases significantly with time into the past. That is inconsistent with the currently favored massive supernovae core collapse hypothesis for GRB's and supports GRB's being cosmic matter / antmatter mutual annihilations. At higher photon energies, corresponding to higher dark matter particle masses, I show that the High Energy Spectroscopic System (HESS) observatory and High-Altitude Water Cerenkov (HAWC) observatory provide unprecedented sensitivities to extended models of dark matter at the TeV and higher mass scales.

2:54PM B2.00008 A Globular effect to the CPT breaking on a Spherical Model of the Universe, Richard Kriske, University of Minnesota — If one accepts the idea that three dimensions can exist in a 4 dimensional Space-Time with Time being perpendicular at each point, then when one looks at the Horizon along the Minkowski Time Line, Space-Time separates into Space and Time at the Horizon. When this happens the symmetry between Space and Time is lost, but Space takes on a Globular (in the simplest model) a Spherical Shape. If one allows a duality between Geometry and Gravitation, one could say that the Geometry of the Sphere causes the Gravitation to come into being or one could say the Gravity causes the Universe to be a Sphere (in the Space dimension with the time dimension being perpendicular). One could claim that through symmetry, any time one could cause the Time Dimension to separate from Space-Time, whether by General Relativity as in this case, or by Special Relativity in a Particle Accelerator, that Mass is created. Another interesting aspect to this in that the Photon seems to have an internal mechanism that keeps track of the the Time Normal. If it where created near the Horizon, when the photon is detected here it is Red Shifted. What does one see for a Photon created on the other side of the Horizon? One could claim that this Time Arrow points in the wrong direction, and this “Wrong Time State” would show up as mass in the same symmetrical way as noted above, giving one another way of generating mass from energy (go beyond the Red-Shift, then tunnel).

3:06PM B2.00009 Conformal theory of galactic halos, Robert K. Nesbet, IBM Almaden Research Center — In current cosmology, an observed galaxy is considered to be surrounded by a large spherical halo attributed to dark matter. Galaxy formation by condensation of mass-energy necessarily depletes the original uniform cosmic background. This must leave a scar, in the form of a gravitational field halo, as observed in anomalous galactic rotation and in gravitational lensing. Without invoking dark matter, conformal theory accounts for the otherwise counterintuitive centripetal effect.

3:18PM B2.00010 The Problem of Big Bang Matter vs. Antimatter Symmetry, Roger Ellman, The-Origin Foundation, Inc. — The equal matter and antimatter of a spherically symmetrical Big Bang should have mutually annihilated. A skew of the symmetry in favor of matter, all of the antimatter annihilating with part of the matter, is deemed to have made an all matter universe. Research seeks a violation of matter / antimatter symmetry to justify that skew. From analysis of the mechanism of mutual annihilation a total annihilation of original Big Bang matter and antiparticle could not have occurred. Our present universe must contain equal amounts of both forms between some particles of which mutual annihilations can occasionally occur, current indication of which is Gamma Ray Bursts (GRB’s). It has been found that the GRB’s rate increases with red shift over the range z = 0 – 4 as about (1 + z)^1.5, which means the rate increases significantly with time into the past. That is inconsistent with the currently favored massive supernovae core collapse hypothesis for GRB’s and supports GRB’s being cosmic matter / antmatter mutual annihilations.

Friday, November 11, 2011 1:30PM - 3:30PM –
Session B3 Condensed Matter Physics I

1:30PM B3.00001 Nuclear spin diffusion in quantum confined semiconductor nanostructures, Daniel Henriksen, Ionel Tifrea, California State University Fullerton — We analyze the nuclear spin diffusion effect in semiconductor quantum wells in connection with dynamical nuclear polarization under optical pumping. The natural confinement provided by the particular geometry of quantum well structures is responsible for a position dependent nuclear spin relaxation time and a reduced nuclear spin diffusion. In particular, we consider the case of GaAs quantum wells within GaAlAs barriers and analyze the nuclear spin diffusion for As nuclei. Our results, obtained for different nuclear spin diffusion constants, show that nuclear spin diffusion has a relatively small effect on the overall polarization of As nuclei in these structures.

1:42PM B3.00002 Transient-Grating Study of Electron and Hole Diffusion in (Ga,Mn)As, Eric Kittlaus, Santa Clara University — Dilute magnetic semiconductors are a class of materials exhibiting both semiconducting and ferromagnetic properties while being chemically similar to traditional semiconductors. This dual nature presents the opportunity for new "spintronic" devices, with the caveat that current dilute magnetic semiconductors are only ferromagnetic above their subzero Curie temperature, Tc. In order to develop new materials functional at room temperature, it is necessary to develop a better theoretical understanding of how such materials become magnetic, a result of microscopic electronic processes. One of the most common dilute magnetic semiconductors, (Ga,Mn)As, is produced by doping Gallium Arsenide with manganese. We use a laser-based experiment, transient-grating spectroscopy, to measure the diffusive motion of electrons and holes in (Ga,Mn)As, which provides information related to the processes which control magnetism in these materials. We present preliminary data and calculations and discuss further improvements in experimental design that will provide unprecedented insight into the microscopic workings of dilute magnetic semiconductors.

1:54PM B3.00003 Spectral and polarization modulation of quantum dot emission in a one-dimensional liquid crystal photonic cavity, Andrea L. Rodarte, C. Gray, L.S. Hirst, S. Ghosh, University of California, Merced — We demonstrate spectral and polarization modulation of chemically synthesized core shell CdSe/ZnS quantum dots (QDs) embedded in a one-dimensional photonic cavity formed by a cholesteric liquid crystal (CLC) matrix. A Cano-wedge cell varies the pitch of the CLC leading to the formation of Grandjean steps. This spatially tunes the photonic stop band, changing the resonance condition and continuously altering both the emission wavelength and polarization state of the QD ensemble. Using high resolution spatially- and spectrally-resolved photoluminescence measurements we find that the emission is elliptically polarized and that the tilt of the ellipse, which means the rate increases significantly with time into the past. That is inconsistent with the currently favored massive supernovae core collapse hypothesis for GRB’s and supports GRB’s being cosmic matter / antmatter mutual annihilations.

1This work is funded by NSF and UC MEXUS.
2:06PM B3.00004 Bulk Nuclear Magnetic Resonance of Topological Insulators 1, D.M. Nisson, A.P. Dioguardi, J. Crocker, P. Klavins, N.J. Curro, Dept. of Physics, UC Davis, N. J. Curro, NMR Team — Topological insulators are materials that are insulating in the bulk but remain conducting on the surface. We present 209Bi nuclear magnetic resonance (NMR) spectra and relaxation rate data on single crystals of Bi2Se3 and Bi2Te2Se. Our preliminary data reveal significant differences in the local electric field gradient between these two materials, and indicate a large anisotropy in the spin–lattice and spin–spin relaxation rates.

2:18PM B3.00005 Nuclear Magnetic Resonance Study of Hidden Order in URu2Si2 2, Kent Shire, Adam Dioguardi, John Crocker, Nicholas APROBERTS-WARREN, Abigail Shockley, Peter Klavins, Nicholas Curro, Department of Physics, University of California, Davis, CA 95616, USA — URu2Si2 is a heavy fermion system that has challenged researchers for many years due to its transition into a hidden order (HO) state at 17.5K. We present new nuclear magnetic resonance (NMR) data near the HO phase transition. An analysis of the spin-lattice relaxation rate and comparisons with other current work, provide insight into understanding the hidden order phase.

2:30PM B3.00006 NMR Studies of pseudogap and electronic inhomogeneity in BSCCO-2212 3, J. Crocker, A.P. Dioguardi, N. APROBERTS-WARREN, A.C. Shockley, UC Davis, H.-J. Grafe, IWF Dresden, Z. Xu, J. Wen, G. Gu, BNL, N.J. Curro, UC Davis — We present O-17 NMR measurements on a single crystal of overdoped BSCCO-2212. We measure the planar oxygen’s Knight shift (K), electronic field gradient (EGF), and spin lattice relaxation rate (1/T1) along each principle axis. Our analysis shows that the temperature dependence can be explained by a suppression of the density of states in the pseudogap region.

2:42PM B3.00007 Jacobi Elliptic Functions and their Application in Classical Mechanics, Superconductivity and Magnetism 4, Thomas E. Baker, Ovidiu E. Icreverzi, Andreas Bill, California State University Long Beach — A differential equation involving a third or fourth degree polynomial may be rewritten in terms of one of three elliptic integrals. These integrals can be inverted to define the Jacobi Elliptic Functions. An application of these functions is to solve non-linear second order differential equations involving circular trigonometric functions sine and cosine. We present solutions of problems in three different areas of physics that have similar Langrangian and associated Euler-Lagrange equations: the bead on a hoop, the Usadel equation of a dirty superconductor and the magnetization twist in a single magnetic layer. We discuss what type of solutions are obtained for these problems and how they relate to each other.

1We gratefully acknowledge the support of the National Science Foundation (DMR-0907242), the Phillip J. Ord Scholarship, the CSU Long Beach Graduate Research Fellowship, and the Army Research Laboratory.

2:54PM B3.00008 Nanoscale Near-Field Spectroscopic Imaging of Four Way Gold Bowtie Nano Antenna Structures 5, Brandon Hessell, Ralph Damato, Terrance Dunlap, California State University Long Beach, James Schuck, University of California Berkeley and Lawrence Berkeley National Laboratory, YoHannes Abate, California State University Long Beach — Nanometer-scale four way gold bowtie nano antenna structures, or “four-ties,” are imaged using scattering-type scanning near-field optical microscopy (s-SNOM) in the mid infrared frequency region. Bowties allow the focusing, manipulation, and steering of light on the nanoscale by making use of an enhanced and confined field in the gap of the nano antenna. The near-field distribution of these four way gold bowtie nano antenna structures show geometric and wavelength dependence as manifested in the amplitude and phase near-field images. Experimental results have also shown strong dependence of the field distribution on the polarization of the incident light.

1This research is partially funded by Research Corporation for Science Advancement and ACS PRF.

2B.S.

3Ph.D.

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3:06PM B3.00009 Testing of a First Order AC Magnetic Susceptometer 6, Ryan Fukuda, Smitha Sunny, Pei-Chun Ho, Department of Physics, California State University, Fresno, California — A first-order AC magnetic susceptibility has been constructed and tested to find the magnetic response of strongly correlated electron materials. The instrument works by using a primary coil to apply a small AC magnetic field of 104 Oe to a sample with a cylindrical coil space of length 635 cm and diameter 355 cm. A lock-in amplifier is used to monitor the induced voltage from a set of secondary coils. By coupling a temperature-controlled system with this instrument, the change in the magnetic signal with respect to temperature is measured. Monitoring the signal changes may indicate how the material to transition to either a ferromagnetic, anti-ferromagnetic, or superconducting state. A 122.47 mg Gd polycrystal was used to test our susceptometer. The data qualitatively agrees with the previous results of magnetization vs. temperature that causes the material to transition to either a ferromagnetic, anti-ferromagnetic, or superconducting state. We discuss what type of solutions are obtained for these problems and how they relate to each other.

1This research is partially funded by Research Corporation for Science Advancement and ACS PRF.

2Ph.D.

3Ph.D.

3:18PM B3.00010 Magnetic Properties of La0.7Sr0.3Mn1-xNixO3 Perovskites 7, Ruben Medina, CSU Dominguez Hills, Blackstead, B.W. Benapfl, University of Notre Dame du Lac, Thomas F. Creel, Missouri University of Science and Technology, Jinbo B. Yang, Mehmet Kahveci, Jagat Lamsal, Satish K. Malik 8, University of Missouri, S. Quezado, International Institute of Physics, O.A. Pringle, William B. Yelion, William J. James, Missouri University of Science and Technology — Using a SQUID magnetometer, we have studied the magnetic properties of La0.7Sr0.3Mn1-xNiO3 (x = 0.05, 0.10, 0.20 and 0.30) perovskites. Both temperature dependent and field dependent magnetic measurements show that the Curie temperature decreases as a function of doping, ranging from 380K in La0.7Sr0.3MnO3 to 300K in La0.7Sr0.3Mn0.7Ni0.3O3. Both magnetic measurements and neutron-diffraction refinements indicate long-range magnetic ordering in samples at low temperature. Transition phases from paramagnetic to ferromagnetic to antiferromagnetic ordering in samples at room temperature.

1and Tatu Institute for Fundamental Research
Material using a Realistic Constitutive Relation
reliable grid computing platforms, which are crucial both to modern science and the operation of entire industries.
numerical solution of escape trajectories. We conclude with the prospects for using the ideas and methods in the design of more efficient and
applicability are illustrated by analyzing transitions between different stable states of a chemical reaction network, supplemented by a fast
behavior as well as recent work applying it. We will briefly discuss large deviations and the formalism of Freidlin and Wentzell for perturbed
systems. This talk will consider some of the challenges, promises, and progress made toward an intuitive statistical theory of non-equilibrium

1:30PM B4.00001 Non-Contact Ultrasound Imaging Applied to Cortical Bone Phan-
toms, PETER HALCROW, KENNETH GANEZER, California State University Dominguez Hills — The purpose of this project was to take
the initial steps towards applying Non-Contact Ultrasound (NCU) to the in-vivo monitoring of osteoporosis and to quantitative ultrasound
imaging (QUS) of the skeleton using cortical bone. This project was also undertaken to find additional applications of NCU beyond its past
limited usage in assessing the severity of third degree burns. With an NCU imaging system, a pair of specially designed broadband 1.5 MHz
non-contact transducers and cortical bone phantoms we determined bone mineral density, speed of sound (SOS), integrated acoustical response
(IR), and ultrasonic transmittance. Air gaps of greater than 3 cm, two transmission and two reflection paths, and a digital signal processor were
used to collect data from phantoms of known mass density and bone mineral density (BMD). Significant correlations between known BMD and
measured SOS, IR, and transmittance were obtained for all 14 phantoms. At least thirty to forty repeated measurements were collected over a
period of 1.5 years of the SOS, thickness, and IR for our phantom set, extending through most of the in-vivo range of BMD found in cortical
bone. The collected data showed a small variation in the range of measurements of plus or minus 1-2 %. These NCU results were shown to be
in agreement with similar results from contact ultrasound to within 1-2%. This study suggests that NCU might find additional applications in
a clinical setting in the near future in medical imaging.

1:42PM B4.00002 Geant4 Microdosimetry for Simulation of Dose Enhancement in
vivo at Orthovoltage Energy1, NICOLE ACKERMAN, Physics Dept, Stanford University, MAGDALENA BAZALOVA, EDWARD GRAVES, Radiation Oncology, Stanford University School of Medicine — Dose-enhanced radiotherapy utilizes high-Z materials at a
tumor site to increase the local dose from external beam radiotherapy. This effect is due to the increased cross section from the photoelectric
effect and the production of Auger electrons. Many past simulations calculated dose in millimeter-scale voxels and ignored heterogeneities in
concentration as well as sites of dose deposition at the cellular scale. We develop a cellular-scale Monte Carlo model using Geant4 to predict
dose enhancement in a variety of scenarios. Gold, tungsten, and iodine are simulated in both in vitro and in vivo geometries. We vary the concentration of the contrast agent both internal and external to the cell, and we measure dose only in the nuclear volume, where DNA damage occurs.

1NA is supported by the Weiland Family and DARE Fellowships.

1:54PM B4.00003 Near-field investigation of plasmonic silver nanowires in the mid
infrared frequency range1, STEFAN MASTEL, TERRANCE DUNLAP, YOHANNES ABATE, California State University Long Beach — We study experimentally the plasmon resonances of silver nanowires (length between 1.5-3 μm) in the mid infrared (IR) (9-11 μm) using scattering-type scanning near-field optical microscopy (s-SNOM). We identify the mid IR plasmon modes of Ag rods at different
polarizations of the excitation laser via near-field phase and amplitude. By varying the wavelength of the incident laser the interaction between closely spaced nanowires is investigated.

1ACS PRF and Research Corporation

2:06PM B4.00004 Foundations and Application of Non-equilibrium
Thermodynamics1, GREGORY ROBINSON, UC Davis and Google — Non-equilibrium thermodynamics provides a powerful
but still unfamiliar way to peer into the properties of systems yet unexplored and holds promise for ready application to important engineered
systems. This talk will consider some of the challenges, promises, and progress made toward an intuitive statistical theory of non-equilibrium
behavior as well as recent work applying it. We will briefly discuss large deviations and the formalism of Freidlin and Wentzell for perturbed
dynamical systems, which recasts certain questions about stochastic processes in the form of Hamiltonian mechanics. The methods and their
applicability are illustrated by analyzing transitions between different stable states of a chemical reaction network, supplemented by a fast
numerical solution of escape trajectories. We conclude with the prospects for using the ideas and methods in the design of more efficient and
reliable grid computing platforms, which are crucial both to modern science and the operation of entire industries.

1Supported by the Santa Fe Institute REU program.

2:18PM B4.00005 Anelastic Seismic Pulse Propagation through a Hysteretic Elastic
Material using a Realistic Constitutive Relation, DAN KOSIK, Butler University — The stress-strain relation
for unconsolidated or slightly consolidated materials that exhibit hysteretic elastic behavior are often modeled for small strains by higher order
terms in the strain with derivative terms or for large strains by linear viscoelastic models. In this way, anelastic behavior is introduced with the
characteristic nonlinear wave propagation that has attenuation and dispersion along with higher harmonics generated. A more natural approach
is to use the Preisach-Mayergoyz method to model the stress-strain relation as due to opening and closing of void spaces in the material.
This leads to a much more realistic stress-strain curve as compared to experimental tests of soil and sand with much of the guess work about
what higher order terms should be included removed. For parameters characteristic of sand and soil at the Earth’s surface, a comparison of
nonlinear to linear seismic pulse propagation shows a nonlinear seismic pulse with a slower propagation speed, dispersion, and attenuation with
the development of higher frequency harmonics. As a source input to a 2D model of surface ground roll generation, nonlinear surface wave
motion can be studied with the aim to better understand how to attenuate this coherent noise contribution to seismic data.

2:30PM B4.00006 Numerical Study of Anelastic Wave Interference in a Hysteretic
Material with Boundary, ANDREW SMITH, DAN KOSIK, Butler University — Many real materials, such as sand, exhibit
complex hysteretic behavior which is not modeled accurately using traditional constitutive relations. In this work, a numerical simulation of
anelastic wave interference in a hysteretic medium is developed using the method of Preisach and Mayergoyz. In our previous work, two-
dimensional anelastic wave propagation from a single cylindrical pressure source was studied. This work focuses on extending this simulation
to include multiple simultaneous pressure sources which interfere with one another. A computational study examines deviations from the linear
theory with a special emphasis on surface wave motion. Applications to geophysics, particularly in prospecting with the seismic reflection
method, will be discussed.
2:42PM B4.00007 100 Years of Superconductivity: Perspective on Energy Applications, PAUL GRANT, W2AGZ Technologies — One hundred years ago this past April, in 1911, traces of superconductivity were first detected near 4.2 K in mercury in the Leiden laboratory of Kammerlingh Onnes, followed seventy-five years later in January, 1986, by the discovery of “high temperature” superconductivity above 30 K in layered copper oxide perovskites by Bednorz and Mueller at the IBM Research Laboratory in Rueschlikon. Vision of applications to the electric power infrastructure followed each event, and the decades following the 1950s witnessed numerous, successful demonstrations to electricity generation, transmission and end use – rotating machinery, cables, transformers, storage, current limiters and power conditioning – employing both low and high temperature superconductors in the USA, Japan, Europe, and more recently, China. Despite these accomplishments, there has been to date no substantial insertion of superconducting technology in the electric power infrastructure worldwide, and its eventual deployment remains problematic. We will explore the issues delaying such deployment and suggest future electric power scenarios where superconductivity will play an essential central role.

2:54PM B4.00008 Indian Summer Monsoon Variability during the Last Millennium, MARY ROOKER, ASHISH SINHA, CSU Dominguez Hills — The seasonal rainfall associated with the Indian summer monsoon during the instrumental period (~last 150 years) is characterized by a biennial oscillation, such that monsoon precipitation varied between singularly strong and weak years but rarely deviated far from its mean state for consecutive years. This observation has led to a hypothesis that monsoon is a self-regulating system, regulated by the annual cycle of the heat balance in the Indian Ocean, mediated by the cross-equatorial ocean heat transport from the summer hemisphere through wind-driven Ekman transport. Consequently, the present day water resource infrastructure and the contingency planning in the region does not take into account the possibility of protracted failures of the monsoon or drastic shifts in its spatial patterns. Here we present new millennial-length speleothem-based reconstructions of Indian monsoon variability from a number of sites across India that challenges the underlying physics of the aforementioned hypothesis. Our proxy records of Indian monsoon provide clear evidence for type of low frequency and high amplitude variability in rainfall that have not been observed during the short instrumental period.

3:06PM B4.00009 Modeling Harpsichord Plucking: The Plectrum and the String, JACK PERNG, Department of Physics, Stanford University, THOMAS ROSSING, JULIUS SMITH, Center for Computer Research in Music and Acoustics, Stanford University — The harpsichord is a plucked string keyboard instrument that was popular during the Renaissance and Baroque music eras. Although it was later replaced by the more expressive piano, it has mounted a comeback due to the early music movement today. A physical model of the harpsichord’s plucking mechanism is presented, detailing the plectrum-string interaction which illustrates many aspects of the harpsichord’s characteristic sound.

3:18PM B4.00010 Optimization of a Small Scale Linear Reluctance Accelerator, THOR BARRERA1, ROBBY BEARD2, Sacramento State University — Reluctance accelerators are extremely promising future methods of transportation. Several problems still plague these devices, most prominently low efficiency. Variables to overcoming efficiency problems are many and difficult to correlate how they affect our accelerator. The study examined several differing variables that present potential challenges in optimizing the efficiency of reluctance accelerators. These include coil and projectile design, power supplies, switching, and the elusive gradient problem. Extensive research in these areas has been performed from computational and theoretical to experimental. Findings show that these parameters share significant similarity to transformer design elements, thus general findings show current optimized parameters the research suggests as a baseline for further research and design. Demonstration of these current findings will be offered at the time of presentation.

1Co-presented with Robby Beard
2Co-presented with Thor Barrera

Friday, November 11, 2011 4:00PM - 5:24PM — Session C1 AMO & HEP Theory

4:00PM C1.00001 A Hybrid Stiff Solver for the Rayleigh-Plesset Equation, MUTAZ ALSAYEGH, CHUNG-MIN LEE, California State University, Long Beach, PRASAD PERLEKAR COLLABORATION, FEDERICO TOSCHI COLLABORATION — We seek to apply efficient computational algorithms to investigate the locations of bubble concentrations in liquid flow. In flow with high velocities, bubbles tend to form in concentrated areas. Moreover, experiments show that bubbles formed at high velocities release large amount of energy once they collapse causing damage to equipment and objects that are in the path of the flow. To gain more insight on the formation of these bubbles, we will first study the dynamics of a single bubble and assume the bubble is a sphere. The dynamics of the bubble in terms of its radius and the driven pressure is modeled by the Rayleigh-Plesset (RP) equation. The RP equation is a second order nonlinear stiff ordinary differential equation (ode) and theoretically, its solution can be obtained numerically using Finite Difference (FD) methods. However, under large pressure variations, the rate of change of the bubble’s radius approaches infinity when the bubble is collapsing. Explicit numerical integration methods require time steps that scale with $\min(t, t)$ to achieve stable solutions. Iterations under this time scale are highly impractical and require immense CPU time. Therefore, a stiff ode solver is needed to alleviate the computation cost. Therefore, we would like to devise a hybrid algorithm that automatically selects between an explicit method and the stiff ode solver. Once we have a robust implementation, we will use it to process the data and analyze the relations between bubble locations and flow structures.

4:12PM C1.00002 Is entanglement signaling really impossible?, JACK SARFATTI, ISEP — Quantum information theory is based on the premise that entanglement cannot be used as a stand-alone communication channel without a classical signal key decoder. The proof depends on linearity of observables, orthogonal base states, and unitary time evolution between measurements of the Schrodinger equation in configuration space. Spontaneous symmetry breakdown giving a Higgs-Goldstone condensate macro-quantum coherent Glauber ground state has a nonlinear non-unitary Landau-Ginzburg equation in ordinary physical space. The Glauber coherent states are non-orthogonal. The conditions for no-entanglement signaling are not satisfied in this case and it may mean the need for a generalized quantum theory that is to orthodox quantum theory as general relativity is to special relativity.

4:24PM C1.00003 Semiclassical Analysis of the Wigner 9J-Symbol with Small and Large Angular Momenta, LIANG YU, ROBERT LITTLEJOHN — We derive a new asymptotic formula for the Wigner 9j-symbol, in the limit of one small and eight large angular momenta, using a novel gauge-invariant factorization for the asymptotic solution of a set of coupled wave equations. Our factorization eliminates the geometric phases completely, using gauge-invariant non-canonical coordinates, parallel transports of spinors, and quantum rotation matrices. Our derivation generalizes to higher 3nj-symbols. We display without proof some new asymptotic formulas for the 12j-symbol and the 15j-symbol in the appendices. This work contributes a new asymptotic formula of the Wigner 9j-symbol to the quantum theory of angular momentum, and serves as an example of a new general method for deriving asymptotic formulas for 3nj-symbols.
4:36PM C1.00004 Scale without conformal invariance , ANDREAS STERGIOU, UCSD — We will present examples of unitary quantum field theories that are scale but not conformally invariant in $d = 4 - 
u$ spacetime dimensions. Such theories exhibit periodic or quasi-periodic renormalization-group trajectories.

4:48PM C1.00005 Introduction to the Geometrical Standard Model of Particle Physics , KEN STRICKLAND, Retired — The Geometrical Standard Model (GSM) of Particle Physics is founded on the principles of a new geometrical tool, Rate Change Graph Technology (RCGT). RCGT was specifically designed to model the complexities of universal concepts. The GSM modeling tool parallels the SM with its own Rate Change Graph Mechanics yet is able to duplicate the SM structure and expand on concepts beyond the SM. RCGT uses a new methodology called geometrical intersections to increase the data available for computing and provides valuable clues as to the missing processes in current scientific practices. Forget about size and value, think geometry and in doing so peel back the layers of the physical world to see for the first time a geometrical universe.

5:00PM C1.00006 ABSTRACT WITHDRAWN —

5:12PM C1.00007 The mass, energy, space and time systemic theory- MEST- The new space-time theory , DAYONG CAO, Beijing Natural Providence Science & Technology Development Co., Ltd — The probability of displacement and period of wave are the space-time. The black hole and its dark planet (dark comet) is made from dark atom. The dark nucleus is made from the dark photon and the dark neutrino, and the dark muon is around it. The dark nucleus has a nuclear energy of the space-time; the black hole radiate the dark proton and the dark neutron like the dark wave (no accretion). We find the dark comet difficulty. But when it impact our earth, it will produce a special “nuclear explosion” which will be produce by the nuclear energy of the mass-energy of stone of earth and the nuclear energy of the space-time of the dark comet together. We can not find its reliquiae of the dark comet. But we can check the abundance of iridium and ‘shocked’ quartz in geological samples around the world. The paper suppose that the Chicxulub Asteroid was the dark comet who Impacted and triggered the mass extinction at the Cretaceous-Paleogene Boundary. (1) $S = P(r) = f^2$. According to the Benford’s law, $(2)^T = P(t) = ln(1 + \frac{1}{1}) = \nu$. Among it, S: the quantum space, f: the amplitude, r: the displacement, T: the quantum time, t: the period, $\nu$: the frequence, P: the probability function. (3) $E'\psi = ih\frac{\partial \psi}{\partial r}$. (4) $m'\psi = -ih\frac{\partial \psi}{\partial t}$. (5) $E''\psi = m''\psi c'^2, (c'^2 = -\frac{\partial \psi}{\partial t})$. Among it, $E''\psi$: the energy of dark wave, $m''\psi$: the mass of dark wave, $E''\psi$: the nuclear energy of black hole, $m''\psi$: the mass of black hole, $c'$: the velocity of dark wave, $\psi$: the Wave Functions.

Friday, November 11, 2011 4:00PM - 5:24PM –
Session C2 Materials Sciences  Bldg 48 - ROB Redwood C/D - Uwe Bergmann, SLAC National Accelerator Laboratory

4:00PM C2.00001 Molecular Dynamics Modeling and Analysis of Actin Network Formation , RONALD PANDOLFI, UC Merced — Actin filaments are ubiquitous and critical in cellular functions. The polymeric protein F-actin is a semi-flexible filament that forms networks in the presence of binding proteins (i.e. $\alpha$-actinin, Filamin, Fascin). Molecular dynamics modeling and simulation of the formation of these networks informs the dependence of network structure on the length and flexibility of these filaments. In comparative experimental work, filament length is controlled by the addition of Gelsolin. The calculation of radial pair distribution functions of simulated actin systems allows quantitative characterization of the network structure by bundling and mesh size.

4:12PM C2.00002 Correlative Characterization of Li-S Batteries Using In situ TXM and XRD , JOHANNA NELSON, SUMOHAN MISRA, Stanford Synchrotron Radiation Lightsource, SLAC National Accelerator Laboratory, YUAN YANG, ARIEL JACKSON, YI CUI, Materials Science and Engineering, Stanford University, JOY ANDREWS, MICHAEL TONEY, Stanford Synchrotron Radiation Lightsource, SLAC National Accelerator Laboratory — Sulfur is an attractive Li-ion battery cathode material candidate because of its high specific energy (2600 Wh/kg); however, it is well known that Li-S batteries suffer from capacity loss or fading. It is generally accepted that this is due to the loss of active material and the formation of nonconducting Li$_2$S as a thin film coating the electrode. Both phenomena stem from the dissolution of active sulfur particles in the non-aqueous electrolyte as soluble long chain polysulfides form during the early stages of cell discharge. Using in situ, high resolution transmission X-ray microscopy (TXM) at SSRL beam line 6-2 and in situ X-ray diffraction (XRD) at beam line 11-3, we have explored initial discharge and charge cycle of Li-S batteries in real time. By combining these complementary methods, we can characterize the morphological changes of the active material as well as changes in crystallinity and crystal structure. We can then correlate these changes and the electrochemistry to better understand the reduction of elemental sulfur and various adaptations employed to retain battery capacity over many cycles.

4:24PM C2.00003 Field Control of the Surface Electroclinic Effect in Liquid Crystal Displays , DANA HIPOLITE, MARO TSIIFTE, KARL SAUNDERS, Dept. of Physics, California Polytechnic State University, San Luis Obispo, CA 93407 — Liquid crystals (LCs) are a fascinating class of materials exhibiting a range of phases intermediate between liquid and crystalline. Smectic LCs consist of elongated molecules arranged in a periodic stack (along z) of liquid like layers. In the smectic-A (Sm-A) phase, the average molecular long axis (director) points along z. In the smectic-C (Sm-C) phase, it is tilted relative to z, thus picking out a special direction within the layers. Typically, the Sm-A* to Sm-C* transition will occur as temperature is decreased. In chiral smectics (Sm-A* or Sm-C*) it is possible to induce director tilting (i.e. the Sm-C* phase) from the Sm-A* phase via the application of an electric field. This is known as the “bulk electroclinic effect” (BECE). Often, e.g. in a LCD, the Sm-A* phase is in contact with a surface. The surface acts as a localized electric field, and induces a local tilt, i.e. a local Sm-C* phase. This “surface electroclinic effect” (SECE) leads to a distortion of the smectic layers, which reduces LCD quality. We present a model of the Sm-A*-Sm-C* transition, including both BECE and SECE. Analysis of this model shows that the SECE can be controlled, and even eliminated, by a bulk electric field.
Doped LiNbO$_3$ has a range of applications in optics, but how these effects emerge from the local structure particularly in doped materials, is poorly understood, as the substitution site(s) is still under debate. We present a detailed analysis of the local structure about Zn (7.3-11.1%) in doped LiNbO$_3$ using the extended X-ray absorption fine structure (EXAFS) technique, in order to determine the defect substitution site. Our analysis shows that even for high Zn concentrations Zn substitutes on the Li site, but the environment about Zn is distorted. From Nb EXAFS the environment about Nb in the host crystal generally agrees very well with diffraction except for the first O shell which appears to have a third longer Nb-O distance - perhaps O on an interstitial site or OH$^-$. 

**5:00PM C2.00006 Exploring Half Metals in Li-based Half Heusler Alloys**
B. BUSEMEYER, University of California, Davis, CA 95616, M. SHAUGHNESSY, Sandia National Laboratories, Livermore, CA 94551, C. Y. FONG, University of California, Davis, CA 95616 — We examine the electronic and magnetic properties of three Li-related half Heusler alloys, namely LiMnN, LiMnP, and LiMnSi in a structure close to the well-known zinc-blende structure in the attempt to search for new half metallic materials. If they do demonstrate half metallic properties, this will open new grounds for finding half metallic spintronic materials. Our results will furnish guidelines for future exploration of alkali-related half metals. Using the primitive cell LiMnSi is a half metal, while the pnictides are not. However when the conventional cell is used, we find that Li$_3$MnP$_4$ and Li$_3$Mn$_2$N$_4$ are half metals. The physical reason for these two pnictides to be half metal and for their magnetic moment per unit cell will be presented.

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**Friday, November 11, 2011 4:00PM - 5:00PM – Session C3 Condensed Matter Physics II**

**4:00PM C3.00001 Evidence of local distortions in the filled skutterudite compounds**
LO$_4$Sb$_{12}$ (L = Nd, Pr, Eu) from EXAFS studies. TREVOR KEIBER, FRANK BRIDGES, UC Santa Cruz — We present a temperature dependent extended x-ray absorption fine structure (EXAFS) analysis on skutterudite compounds of the form LO$_4$Sb$_{12}$ for L the rare earth elements Nd, Pr, Eu. We find that the L-Sb and Os-Sb peaks are well ordered while the X-Os and Os-Os peaks show anomalous behavior for X = Nd and Pr. We propose a distortion of the lattice structure to account for these changes.

**4:12PM C3.00002 EXAFS Analysis of the Local Structure of Thermoelectric Clathrates**
SCOTT MEDLING, MICHAEL KOZINA, FRANK BRIDGES, UC Santa Cruz — We present local structure studies of clathrates (types I, II, and VIII) using the extended X-ray absorption fine structure (EXAFS) technique. The presence of a rattler atom located in the center of one of the cages in the unit cell is believed to strongly scatter phonons and be the origin on the low thermal conductivity that makes these materials promising for thermoelectric applications. We compare a large number of similar clathrates to understand how the local structure explains the electrical and thermal conductivities. For several compounds, including Ba$_4$Ga$_{16}$Sn$_{30}$, EXAFS analysis shows that the local distances are different than average values found from diffraction and show greatly increased disorder compared to Ba$_4$Ga$_{16}$Ge$_{30}$, suggesting that the cage structure is severely distorted, scattering both phonons and electrons, and accounting for the lower thermoelectric figure of merit.

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1 NSF grant DMR-1005568.
4:24PM C3.00003 Probing Bulk Electronic Structure with Hard x-ray Angle-Resolved Photoemission, ALEXANDER GRAY, SLAC National Accelerator Laboratory, Menlo Park, CA, USA, JAN MINAR, Department of Chemistry, Ludwig Maximilian University, Munich, Germany, SHIGENORI UEDA, NIMS Beamline Station at SPring-8, Hyogo, Japan, JUERGEN BRAUN, HUBERT EBERT, Department of Chemistry, Ludwig Maximilian University, Munich, Germany, OSCAR DUBON, Department of Materials Science and Engineering, University of California Berkeley, Berkeley, CA, USA, KEISUKE KOBAYASHI, NIMS Beamline Station at SPring-8, Hyogo, Japan, CHARLES FADLEY, Department of Physics, University of California Davis, Davis, CA, USA. — Traditional ultraviolet and soft x-ray angle-resolved photoemission spectroscopy (ARPES) may in some cases be too strongly influenced by surface effects to be a useful probe of bulk electronic structure. Going to hard x-ray photon energies and thus larger electron inelastic mean-free paths should provide a more accurate picture of bulk electronic structure. I will present the first experimental data for hard x-ray ARPES at energies of 3.2 and 6.0 keV. The systems discussed are W, as a model transition-metal system to illustrate basic principles, and (Ga,Mn)As, as a technologically-relevant ferromagnetic semiconductor material to illustrate the potential broad applicability of this new technique. The experimental results are compared to free-electron final-state model calculations and more precise one-step photoemission theory including matrix element effects. Some likely future applications areas are discussed.

4:36PM C3.00004 Ghost critical field and weak localization phenomena in superconducting Tantalum Nitride films, NICHOLAS BREZNAY, AHARON KAPITULNIK, Stanford University. — We study the appearance of superconducting fluctuations and weak localization effects in a disordered thin film of Tantalum Nitride using magnetotransport measurements. At temperatures above Tc, we observe a large positive magnetoresistance that is 4 orders of magnitude larger than the predicted classical effect. Well above Tc this behavior is consistent with the magnetic field dependence of localization quantum corrections to the conductivity in the presence of strong spin-orbit scattering. Close to Tc and at low magnetic fields the observed magnetoresistance is well described by recent theories that describe both localization and superconducting fluctuations effects. This analysis allows for quantitative study of the inelastic scattering time and the so-called ghost critical field.

4:48PM C3.00005 Electron and magnetic instabilities in Betts lattices with next nearest neighbors: exact results, ARMEN KOCHARIAN, California State University Los Angeles, GAYANATH FERNANDO, KUN FANG, University of Connecticut, CINT TEAM. — The spontaneous phase transitions and quantum critical points in the repulsive (t > 0) Hubbard model with nearest and next nearest neighbor coupling (t_{nnn}), accompanied by (local) charge and spin density inhomogeneities, are studied by exact diagonalization of isotropic Betts cells (8- and 10-site squares) with periodic boundary conditions. The first order phase separation instabilities are found by monitoring charge and spin gaps under the variation of electron density (doping) and magnetic field in a wide range of interaction strength U and t_{nnn}. The coupled opposite spins and paired charge of electrons (holes), complied with Bose-Einstein statistics at zero temperature and moderate U, suggests full Bose condensation and coherent pairing of electrons in real space with equal gaps (similar to the unique BCS quasiparticle gap). However, a separate pairing of charge and spin degrees at distinct condensation temperatures offers a new route to superconductivity different from the BCS scenario. The conditions for spin liquid, unsaturated and saturated Nagaoka-like ferromagnetism due to spin-charge separation at large U values are also established. The criteria for enhanced coherent electron pairing and saturated ferromagnetism driven by t_{nnn} are considered.

Friday, November 11, 2011 8:30PM - 9:06PM
Session D1 After Dinner Speech
University Club Palo Alto - Lynn Cominsky, Sonoma State University

8:30PM D1.00001 After Dinner Talk and Discussions: Energy Policy Today, BURTON RICHTER, SLAC

Saturday, November 12, 2011 1:00PM - 3:00PM
Session F1 Nuclear Physics
Bldg 48 - ROB Redwood A/B - Karl Van Bibber, Naval Postgraduate School

1:00PM F1.00001 Beta-delayed neutron spectroscopy using trapped radioactive ions, RYAN YEE, UCB/LLNL, N.D. SCIELZIO, LLNL, P.F. BERTONE, ANL, F. BUCHINGER, McGill U, S. CALDWELL, UChicago/ANL, J.A. CLAYTON, C.C. DE RUIZ, UCB/LLNL, G. LI, UC BERKELEY, ANL, S. GULICK, McGill U, D. LASCAR, Northwestern U/ANL, A.F. LEVAND, ANL, E.B. NORMAN, UCB/LLNL, M. PEDRETTI, LLNL, G. SAVARD, UChicago/ANL, R.E. SEGEL, Northwestern U/ANL, K.S. SHARMA, UManitoba, M.G. STERNBERG, J. VAN SCHELT, UChicago/ANL, B.J. ZABRANSKY, ANL. — The properties of beta-delayed neutron emission are of interest to both the basic and applied nuclear physics communities. For example, branching ratios are needed to determine how the short-lived neutron-rich isotopes synthesized in the astrophysical r process decay back to stability to become the isotopes we observe today. Also, neutron-rich isotopes are used as experimental and theoretical probes of nuclear reactions. Reliable measurements of the beta-delayed neutron properties can be performed with unprecedented precision using an ion trap surrounded by radiation detectors. When a radioactive ion decays in the trap, the recoil-daughter nucleus and emitted particle emerge from the ~1 mm$^3$ trap volume with minimal scattering. These properties allow the momentum and energy of the emitted neutron to be precisely reconstructed from the nuclear recoil. Spectroscopy of beta-delayed neutrons can be performed with high efficiency, energy resolutions approaching ~0.5%, and virtually no background. Results from a recent proof-of-principle experiment will be discussed. Prepared by LLNL under Contract DE-AC02-07CH11357.

9:36AM E1.00002 Melting of a Quasiparticle in Cuprate Superconductors, ALESSANDRA LANZARA, UC Berkeley. —
The analysis of these data is in progress and is anticipated to widen the kinematic range and considerably improve the precision of the measurements. The status of the analysis will be discussed.

Considerably larger data samples corresponding to 6.5 pb$^{-1}$ reported shape to determine the total Upsilon(1S+2S+3S) yield from the RHIC (STAR) detector is used to identify Upsilon. The longitudinal spin transfer, deconfinement and of the medium temperature. In addition, bottomonia is expected to be less affected than charmonia by recombination and is theorized to be one of the best probes of the hot, dense matter produced in relativistic heavy ion collisions. It is expected to be a good test of the phase boundary. In this talk, we will present preliminary pion yields from Au+Al collisions at 8.85 AGeV and $\sqrt{s}$ of 4.5 GeV. Comparisons will be made to results from the AGS heavy ion program as well as UrQMD simulations.

The longitudinal spin transfer, $D_{LL}$, of $\Lambda$ and $\bar{\Lambda}$ hyperons in longitudinally polarized proton-proton collisions is sensitive to the polarization of strange quarks and anti-quarks in the polarized protons, as well as polarized fragmentation. The STAR collaboration previously reported $D_{LL}$ from a data sample obtained in 2005 that corresponds to an integrated luminosity of 2 pb$^{-1}$ with 50% beam polarization. Considerably larger data samples corresponding to 6.5 pb$^{-1}$ and 25 pb$^{-1}$ with beam polarization of 57% were obtained in 2006 and 2009. The analysis of these data is in progress and is anticipated to widen the kinematic range and considerably improve the precision of the $D_{LL}$ measurements. The status of the analysis will be discussed.

STAR Extracted Upsilon(1S+2S+3S) Yield from the RHIC 2009 p+p $\sqrt{s} = 200$ GeV run. Andrew Peterson, UC Davis, STAR Collaboration — Upsilon meson production is of particular interest in heavy ion physics because the suppression of excited Upsilon states (2S and 3S) compared to the ground state (1S) is theorized to be one of the best probes of the hot, dense matter produced in relativistic heavy ion collisions. It is expected to be a good test of deconfinement and of the medium temperature. In addition, bottomonia is expected to be less affected than charmonia by recombination and hadronic co-mover absorption. Enhancement or suppression is quantified by the nuclear modification factor $R_{AA}$. The Solenoidal Tracker at RHIC (STAR) detector is used to identify Upsilon $\rightarrow e^-e^+$. $e^-e^+$ from the Drell-Yan (DY) process and b-bbar continuum can also reconstruct to a similar invariant mass (IM) as the Upsilon. The DY and b-bbar backgrounds are determined by fitting a functional form including a parameterization of the trigger activation to the like-sign electron pair IM spectrum. The fit is combined with the Upsilon(1S+2S+3S) line shape to determine the total Upsilon(1S+2S+3S) yield from the $e^-e^+$ IM spectrum. We present preliminary results on the total extracted Upsilon(1S+2S+3S) yield produced in STAR during the Relativistic Heavy Ion Collider (RHIC) 2009 p+p $\sqrt{s} = 200$ GeV run.

Detector Efficiencies of the Dielectron Decay of the Upsilon Meson from a Single Electron Simulation. Kurt Hill, University of California, Davis, STAR Collaboration — In the analysis of heavy flavor meson production in high energy hadron collisions, it is important to have an accurate estimation of efficiencies in order to determine total yield. To calculate these efficiencies at the STAR detector, we use a method called embedding in which simulated particles are embedded into real event data. Because the embedding process is computationally intensive and requires a significant amount of time, we have developed a method to simulate the embedding of the dielectron Upsilon decay using only single electron embedding data. This enables us to extract the relevant information without having to generate a new data set, thus saving computation time. We present the motivation, method, and results of extracting Upsilon efficiencies from single electron embedding at STAR.

Supported by the US Dept. of Energy
2:36PM F1.00009 Design and Construction of the High Threshold Čerenkov Counter Mirror Assembly for the CLAS12 detector at JLab1, HARNEET GREWAL, JOHN PRICE, CSU Dominguez Hills, YOURI SHARABIAN, Thomas Jefferson National Accelerator Facility — An overview is presented of the design and construction of the High Threshold Čerenkov Counter (HTCC) mirror assembly to be placed in the forward region of the CLAS12 detector at the Thomas Jefferson National Accelerator Facility (JLab). The CO2 gas HTCC has a pion momentum threshold of 4.9 GeV/c, and will provide improved muon-positron separation at the higher energies that will be produced after the JLab 12 GeV upgrade is complete. The location of the HTCC in the forward detector requires that it be built with a minimal amount of material to limit the contamination of the momentum resolution due to multiple scattering events. This talk will demonstrate how this was achieved by using low mass composites. Also presented will be highlights of the innovative geometry of the design as well as the manufacturing process being implemented in order to maximize quality control.

1Supported by the US Dept. of Energy

2:48PM F1.00010 No blackhole and no atomic bomb, PHILIP SHIN — Title: c=c(1+1=2). The light speed 1+1=2. So we count the number by step by step for one point. When we count the number by one point, we use the number written on the paper. This means this is not number, but the graph and line. The light speed is the truth in physics. I can prove it by number. 10%=0.1 As %=kg So 10kg=0.1 kg=1/10 x 1/10 kg=1/100 And 100%=1 So kg=100%/100%=% So 1kg=1%/1=100 E=m*c² So cx kg x m²/sec² = 1kgx cx m²/sec² cx 1/100x m²/sec² = 1/100x cx m²/sec² So c<100=c/100 So c=c And c is the truth never changed. Title: By faith, no blackhole As to be, we glory to God and that is basic theology for christian. And I want to say that BE means just thinking. There is no clue of nature and no proposition to prove it. I just believe by feeling and emotion. I trust that it can be the physic really. There are only human beings and there is no idol that is different existence from human beings, that is true to be. So the nature we see is zero and we, human beings make the zero nature as from no start and no ending. No alpha and omega mean we are idol and that there is no blackhole. Blackhole means the block is existing in the nothing(as we are no alpha and no omega). So the block cannot be existence. So if there is blackhole, then there must be the wall to block me and never walk again. The big bang and evolution mean they are no alpha and no omega and existing by themselves. So they could be existence, but big bang and evolution are just logical fact to be. We need faith as God give us the direction into our spirit.

Saturday, November 12, 2011 1:00PM - 2:48PM –
Session F2 High Energy/Accelerator Physics Bldg 48 - ROB Redwood C/D - Ken Ganezer, CSU Dominguez Hills

1:00PM F2.00001 Experimental Analysis of Gaseous Chambers for the ATLAS Muon sub-detector Upgrade R&D1, EMMANUEL ANGULO, CSU Fresno, JOERG WOTSCHECK, CERN, ATLAS MUON CHAMBERS R&D ON MICROMEGAS TEAM — CERN, the world’s largest particle accelerator facility, has begun its ambitious Large Hadron Collider (LHC) program which is and will remain as the world energy frontier until at least 2030. ATLAS, one of the LHC experiments designed to search for new physics, has been taking data for two years. ATLAS has been investigating the necessary changes to its sub-detectors to withstand much higher instantaneous luminosity and to operate after 3000 fb-1 of integrated data. The goal is to achieve the same or better performance (spatial resolution, etc.) despite the large increase in event rate and final integrated dose. The current ATLAS Muon sub-detector will not be able to handle the increased luminosity of a factor of ten. This makes it necessary to replace the current muon sub-detector by possible new gaseous chambers that push their performance to limits never tested before. This talk will focus on the different lab experiments performed at CERN, including a test beam run, and the exciting results on two of the latest chamber prototypes (R19M and R19G) developed by the ATLAS Muon detector upgrade R&D team. This is the research project the author did at CERN during summer 2011.

1Department of Physics, California State University, Fresno

1:12PM F2.00002 Improved Simulations for New Physics Searches at ATLAS, NAVID RAD, CSU Fresno, ATLAS, CERN COLLABORATION — ATLAS experiment at the Large Hadron Collider (LHC) of CERN is designed to make new discoveries in particle physics. Some of the possible findings are the Higgs boson, supersymmetry (SUSY), extra spatial dimensions, micro-black holes and a whole zoo of other exotic possibilities. However, before looking for these new possibilities, one needs to verify our current theories and understanding of physics at the level of Quantum Chromodynamics (QCD). Since HEP experiments look for rare events, the amount of data that needs to be analyzed is astronomical. Also the fact that the comparison of the experiment to data is often done by using event generators such as Pythia makes the process of analysis extremely time consuming. The purpose of this research project is to utilize and develop additional software tools in order to decrease the time and computing power required for calculations done at ATLAS. The APPLgrid software package allows for quick calculations with any parton distribution function (PDF) which could take only a few milliseconds where as the same calculation using Pythia could take weeks for each PDF. The results that will be shown in this presentation are some sample calculations done by APPLgrid and also the comparison with similar calculations done by Pythia at the level of QCD and beyond. This is a research project the author did at CERN during the summer of 2011.

1:24PM F2.00003 Jets in ATLAS Data from Fresno's Tier 3 Computing System1, ARYA AFSHARI, California State University, Fresno, ATLAS COLLABORATION — California State University, Fresno is the only CSU campus on the ATLAS experiment at the Large Hadron Collider (LHC) of the European Organization for Nuclear Research (CERN). Fresno’s Tier 3 cluster is part of the ATLAS Grid Computing system which stores part of ATLAS data (~10 PB per year) and allows for students to analyze raw data and generate Monte Carlo events. The proton-proton collisions recorded by the ATLAS detector are analyzed in order to identify sprays of new particles (known as jets). The jets are characterized by their transverse momentum, angle which the cone axis makes with respect to the beam axis (rapidity), and the angle at which the cone encircles the beam axis (phi). When analyzing these jets in raw data, it is extremely difficult to distinguish jets created by possible new physics processes from jets created by known physics processes (QCD backgrounds). Monte Carlo simulations do not have such QCD backgrounds and are thus essential in calibrating the detector with known physics. We use ROOT to find the transverse momentum, rapidity, and phi of the jets. The jet with the greatest transverse momentum is significant to us because it is more likely to contain new particles. Having found the jet with the highest transverse momentum from the simulations, we know where to look in the raw data for potential new physics. These ATLAS Monte Carlo simulations of jets are from the authors' summer 2011 work at CERN.

1College of Science and Mathematics, Instructional Related Activities, Faculty Sponsored Student Research
1:36PM F2.00004 Plasma Wakefield Acceleration Experiments at FACET1
MICHAEL LITOS, MARK HOGAN, SLAC National Accelerator Laboratory, FACET PLASMA WAKEFIELD ACCELERATION COLLABORATION — FACET (Facility for Advanced Accelerator Experimental Tests) is a new facility at SLAC primarily dedicated to the study of beam-driven plasma wakefield acceleration (PWFA), an advanced particle acceleration technique which can produce longitudinal electric fields that are orders of magnitude stronger than those in conventional metal structures, and can sustain those fields over a distance of meters. These features make PWFA an attractive technology for the design of future linear colliders and light sources. The experiments at FACET will roughly mimic a single stage of a plasma-based accelerator by demonstrating the uniform acceleration of a discrete electron witness bunch, increasing its energy by about 20 GeV over a distance of 1 m in a plasma wake induced by a separate driver bunch of electrons. Another major goal of FACET is to study PWFA using various combinations of positrons and electrons in the roles of driver and witness bunch for the first time.

1Work supported by the U.S. Department of Energy under contract number DE-AC02-76SF00515.

1:48PM F2.00005 Recent results from Super-Kamiokande on searches for neutron oscillation, Baryon Number violation, and other related studies1, DYLAN NICHOLAS, KENNETH GANEZER, California State University Dominguez Hills, SUPER-KAMIOKANDE COLLABORATION — In this talk we will review the final results on a search for neutron oscillation in Super-Kamiokande-I, which were very recently submitted to the high energy physics archive as arXiv:1109.4227 [hep-ex] (at http://arxiv.org/abs/1109.4227) and submitted by us on behalf of the Super-Kamiokande collaboration to Physical Review Letters. These studies set new lower limits on neutron oscillation which include the major sources of systematic errors and constrain R-L symmetric theories of Grand Unification, from studies which have involved undergraduate students and physicists from CSUDH for several years. We will also discuss other recent measurements from Super-Kamiokande involving searches for Baryon number violation, neutrino astrophysics, and studies of neutron oscillations and the student involvement in this research. This research is funded at CSUDH by grant # NSF 0901048 (to CSUDH) from the NSF Particle-Astrophysics program.

1Recent results from Super-Kamiokande on searches for neutron oscillation, Baryon Number violation, and other related studies. This project is funded at CSUDH by grant # NSF 0901048 (to CSUDH) from the NSF Particle-Astrophysics program.

2:00PM F2.00006 Searching for new light bosons with the Axion Dark Matter Experiment (ADMX)1, GIANPAOLO CAROSI, Lawrence Livermore National Laboratory, ADMX COLLABORATION — The axion is a neutral pseudoscalar boson predicted to exist as a consequence of the Peccei-Quinn solution to the Strong-CP problem. Axions with masses between $\mu$eV - meV are also a natural dark matter candidate. The Axion Dark Matter Experiment (ADMX) searches for dark matter by looking for their resonant conversion to detectable photons via the Primakoff Effect in a microwave cavity immersed in a strong static magnetic field. Here I will discuss the operating principles of the ADMX experiment along with results from recent data runs and progress towards the next phase of the experiment currently being constructed at the University of Washington. The sensitivity of ADMX to other new light bosons such as chameleon particles and hidden-sector-photons will also be discussed.

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

2:12PM F2.00007 The Microstrip SQUID Amplifier: Upgrading the Axion Dark Matter Experiment (ADMX)1, JOHN CLARKE, University of California, Berkeley, DARIN KINION, Lawrence Livermore National Laboratory, ADMX COLLABORATION — The axion detector, now at the University of Washington, Seattle, requires a very low noise amplifier in the 1-GHz frequency range. In the first generation detector, the cavity was cooled to 1.5 K and used a HEMT (High Electron Mobility Transistor) amplifier with a noise temperature $T_N$ of 1.7 K. Thus, the system noise temperature $T_s$ was 3.2 K. To achieve significantly lower noise temperatures, we developed the Microstrip SQUID Amplifier (MSA) in which the input coil forms a microstrip with the SQUID washer. When the length of the coil corresponds to a half-wavelength of the signal, the gain is typically 20 dB. We measured the gain and noise of an MSA at 0.62 GHz, and achieved a minimum noise temperature $T_N = 4.8 \pm 5$ mK for a bath temperature of 50 mK and at a frequency slightly below resonance, as predicted. The quantum limit is 30 mK. Since the time for the axion detector to scan a given frequency range scales as $T_s^3$, replacing the HEMT with a SQUID and cooling the cavity to 50 mK potentially reduces the scan time by three orders of magnitude. In a proof-of-principle run, the system was operated at 1.7 K with an MSA readout, and performed as predicted. A total of 88,370, 80-second data sets were acquired, corresponding to 82 days of data acquisition.

2:24PM F2.00008 Constraints on a Minimal Flavor Violating Sector from Electroweak Precision Data, CHRISTOPHER W. MURPHY, UCSD — We examine the electroweak physics of a new physics sector that is symmetric under the Standard Model quark flavor group, $G_F = SU(3)_Q \times SU(3)_D \times SU(3)_H$. Constraints on vector boson representations of this sector are analyzed using their contributions to the self-energies of the EW gauge bosons. Vector masses close to the electroweak symmetry breaking scale are found to be consistent with precision data in almost all of the allowed representations, and in certain cases an EWSB scale mass is possible in a large region of parameter space.

2:36PM F2.00009 $\alpha$-quantized Einstein masses for leptons, quarks, hadrons, gauge bosons, and Higgs constants, MALCOLM MAC GREGOR, Lawrence Livermore National Laboratory (Retired) — The Einstein particle mass $e_i$ is defined by the equation $e_i = E_i / c^2$. The basic particle ground states have unique additive Einstein masses (energies), and they interleave in $\alpha$-quantized ($\alpha^{-1} = 137$) energy plots to form distinctive excitation patterns. The $SU(3)_{Q,D}$ Einstein masses are constituent-quark masses. Particle generation proceeds via "$\alpha$-boosted" boson, fermion, and gauge-boson "unit masses," which are "bundled" together to form particles and quarks. The Einstein mass equations extend throughout the entire range of particle masses. Lederman and Hill1 note that the scalar Higgs and Fermi fields are at the 175 GeV energy scale of the top quark $t$, and they suggest the Higgs coupling constant equation $g_e = m_e / m_t = 0.0000029$, which matches the Einstein mass expression $g_e = \alpha^2 / 18$.

1:00PM F3.00001 Growth of Iridium on Ge(111) Studied by STM1, MARSHALL VAN ZIJLL, CORY MULLET, BRET STENGER, EMLILIE HUFFMAN, DYLAN LOVINGER, WILLIAM MANN, SHIRLEY CHIANG, UC Davis — We have used scanning tunneling microscopy (STM) to characterize the growth of iridium onto Ge(111) as a function of coverage and annealing temperature. Iridium was deposited onto the Ge(111) c(2×8) surface at different coverages less than 1 ML, and then annealed to temperatures between 600K and 700K. The iridium forms islands which generally increase in size with increasing annealing temperature. In addition to island formation, other unique characteristics were observed, including the formation of Ir pathways connecting the islands. High resolution images have been obtained, which allow direct observation of the different phases.

1Funding from NSF CHE-0719504 and NSF PHY-1004848 (REU)

1:12PM F3.00002 LEEM and STM studies of Ag on Ge (110)1, BRENT STENGER, CORY MULLET, MARSHALL VAN ZIJLL, EMLILIE HUFFMAN, DYLAN LOVINGER, SHIRLEY CHIANG, University of California Davis — The growth of Ag deposited on Ge(110) was studied with low energy electron microscopy (LEEM) and scanning tunneling microscopy (STM). The LEEM studies showed the formation of long one dimensional islands as Ag was deposited above 430°C. Island nucleation proceeded from defects in the Ge substrate. During deposition, the length of the islands increased while the width remained constant. The size and distribution of the islands was dependent on the substrate temperatures during deposition. At 480°C, islands were 100 nm wide and 1-2 µm long at 9 ML of coverage. At 530°C, islands were 200 nm wide and 1-3 µm long at 9 ML of coverage. STM images showed that the islands were composed of Ag and that the surface regions between the islands exhibited a reconstruction which is characteristic of pure Ge.

1Funding from NSF CHE-0719504 and NSF PHY-1004848 (REU)

1:24PM F3.00003 Phase competition in trisected superconducting dome, INNA VISHIK, Stanford University, M. HASHIMOTO, Stanford Synchrotron Radiation Lightsource, R.-H. HE, Advanced Light Source, Lawrence Berkeley National Lab, W.-S. LEE, F. SCHMITT, Stanford University, D.-H. LU, R.G. MOORE, Stanford Synchrotron Radiation Lightsource, C. ZHANG, Shandong University, W. MEEVASANA, Suranaree University of Technology, T. SASAGAWA, Tokyo Institute of Technology, S. UCHIDA, University of Tokyo, K. FUJITA, Cornell University, S. ISHIDA, University of Tokyo, M. ISHIKADO, Japan Atomic Energy Agency, Y. YOSHIDA, H. EISAKI, Nanoelectronics Research Institute, Z. HUSSAIN, Advanced Light Source, Lawrence Berkeley National Lab, T.P. DEVEREAUX, Z.-X. SHEN, Stanford University — Angle resolved photoemission spectroscopy (ARPES) has been used to distinguish between quantum phases in the cuprates, particularly superconductivity and the pseudogap, based on their distinct spectroscopic phenomenology—temperature, doping, and momentum dependence. We present new ARPES experiments showing evidence for three distinct phases comprising the superconducting ground state in Bi2Sr2CaCu2O8+δ (Bi-2212), accompanied by abrupt changes at p≈0.076 and p≈0.19 in the phenomenology of the superconducting gap near the bond-diagonal (nodal) direction. The latter likely marks the quantum critical point of the pseudogap, while the former may indicate a distinct competing phase at low doping. Temperature dependence studies of energy gaps provide further support for this characterization, and additionally present evidence that the pseudogap is not static below Tc.

1:36PM F3.00004 Phase transitions in dense nitrogen and carbon dioxide liquids1, BRIAN BOATES, STANIMIR BONEV, Lawrence Livermore National Laboratory — The high-pressure phase diagrams of liquid nitrogen and carbon dioxide have been investigated using first-principles theory. Both liquids undergo rare first-order molecular-polymerization phase transitions at pressures comparable to their solid counterparts. Furthermore, both materials dissociate into metallic atomic fluids at high temperatures. The liquid regimes of their phase diagrams have been divided into several regions based on detailed analyses of changes in both structural and electronic properties for pressures and temperatures up to 200 GPa and 10,000 K, respectively. A comparison of the two liquid phase diagrams will be discussed to illustrate similarities and differences. Calculations of the shock Hugoniot are in excellent agreement with available experimental data.

1Performed under DOE Contract No. DE-AC52-07NA27344.

1:48PM F3.00005 Boundary of Phase Co-existence in Docosahexaenoic Acid System, CHAI LOR, LINDA S. HIRST, University of California, Merced — Docosahexaenoic acid (DHA) is a highly polyunsaturated fatty acid (PUFA) that exhibits six double bonds in the hydrocarbon tail. It induces phase separation of the membrane into liquid order and liquid disorder in mixtures containing other lipids with more saturation and cholesterol. With the utilization of atomic force microscopy, phase co-existence that exhibits six double bonds in the hydrocarbon tail. It induces phase separation of the membrane into liquid order and liquid disorder in mixtures containing other lipids with more saturation and cholesterol. With the utilization of atomic force microscopy, phase co-existence has been obtained, which allow direct observation of the different phases.

2:00PM F3.00006 Third Sound in Superfluid Helium Films Adsorbed on Packed Multiwall Carbon Nanotubes1, REBECCA ROYCROFT, EMIN MENACHEKIAN, GARY WILLIAMS, University of California, Los Angeles — We are studying the propagation of third sound in thin 4He films adsorbed on multiwall carbon nanotubes. The nanotubes of 12.5-nm average diameter are lightly packed into an annular resonator, with a resistor bolometer used to detect temperature oscillations accompanying the waves. Standing acoustic waves are excited by mechanical vibrations as well as heater drive, with FFT analysis allowing measurement of both the sound speed and dissipation. Initial experiments showed split harmonic frequencies, which have been resolved in a subsequent experiment using a different packing scheme. We observe the KT onset transition, and then at higher thicknesses capillary condensation becomes important. At 1.3 K we do not observe layering effects; lower-temperature measurements may be necessary to see these effects.

1This research has been supported by the National Science Foundation, Grant No. DMR 09-06467.

2:12PM F3.00007 Experimental Probe for Measurement of Thermodynamic Properties, NICHOLAS SOLIZ, ULISES URBINA, PEI-CHUN HO, Department of Physics at CSU, Fresno — Our measurement probe was designed and built to measure thermoelectric power (TEP; Seebeck coefficient) and thermal conductance. This measurement probe is custom made to fit in our cryocooler refrigerator for the temperature range from 11 K to 300 K. By using a small, 2Ω resistor heater, and careful thermal isolation, we can apply a temperature gradient across our samples. We then monitor the raw trace of temperature and thermoelectric voltage as a function of time. Later, we extract the thermal conductance and the TEP by using the thermal equilibrium data. Automated data acquisition from room temperature to ∼12 K is obtained using LabVIEW software. Calibration of the measurement probe was performed on a Nickel sample and the measured TEP is compared to literature values to demonstrate the accuracy. The probe is being developed and calibrated for use in our investigation of TEP and thermal conductivity in single crystal samples of Pr1−xNd0.15Sb12 in the future.
WEP has not been performed below the millimeter scale. This talk will discuss the improved sensitivity that we expect to achieve in short-range force requires highly isolated experimental systems and precise measurement and control instrumentation. Moreover, a dedicated test of the attributed to Dark Energy. The weakness of the gravitational force makes measurement very difficult at small scales. Testing such a minimal are also instrumental in investigating possible proposed mechanisms that attempt to explain the accelerated expansion of the universe, generally unobserved subatomic particles, which if exist, could cause a violation in the WEP at short distances. Some models also predict unobserved subatomic particles that may cause short-range violations of the Weak Equivalence Principle. At Humboldt State University, undergraduates and faculty are developing an experiment that will test gravitational interactions below the 50-micron distance scale. The experiment will measure the twist of a torsion pendulum as an attractor mass is oscillated nearby in a parallel-plate configuration, providing a time varying torque on the pendulum. The size and distance dependence of the torque variation will provide means to determine deviations from accepted models of gravity on untested distance scales. To observe the twist of the pendulum inside the vacuum chamber, an optical system with nano-radian precision is required. This talk will focus on the current status of the experiment, and the development of an optical system with the required sensitivity.

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1:00PM F4.00001 Novel Tests of Short-range Gravitational Physics at Humboldt State University1, HOLLY LEOPARDI2, BRANDON BAXLEY3, C.D. HOYLE, MATTHEW RICHARDS4. Humboldt State University, DAVID SHOOK, CENPA (University of Washington) and Humboldt State University — Due to the incompatibility of the Standard Model and General Relativity (GR), tests of gravity remain at the forefront of experimental physics. There is yet to be a theory that unifies inconsistencies between GR and quantum mechanics; however, some scenarios of String Theory predict more than three spatial dimensions that could alter the gravitational inverse-square law at short distances. Some models also predict unobserved subatomic particles that may cause short-range violations of the Weak Equivalence Principle. At Humboldt State University, undergraduates and faculty are developing an experiment that will test gravitational interactions below the 50-micron distance scale. The experiment will measure the twist of a torsion pendulum as an attractor mass is oscillated nearby in a parallel-plate configuration, providing a time varying torque on the pendulum. The size and distance dependence of the torque variation will provide means to determine deviations from accepted models of gravity on untested distance scales. To observe the twist of the pendulum inside the vacuum chamber, an optical system with nano-radian precision is required. This talk will focus on the current status of the experiment, and the development of an optical system with the required sensitivity.

1Supported by NSF award PHY-1065697
2undergraduate presenter
3undergraduate
4undergraduate

1:12PM F4.00002 Predicted Sensitivity for Tests of Short-range Gravity with a Novel Parallel-plate Torsion Pendulum1, MATTHEW RICHARDS2, BRANDON BAXLEY3, C.D. HOYLE, HOLLY LEOPARDI4. Humboldt State University, DAVID SHOOK, CENPA (University of Washington) and Humboldt State University — The parallel-plate torsion pendulum apparatus at Humboldt State University is designed to test the Weak Equivalence Principle (WEP) and the gravitational inverse-square law (ISL) of General Relativity at unprecedented levels in the sub-millimeter regime. Some versions of String Theory predict additional dimensions that might affect the gravitational inverse-square law (ISL) at sub-millimeter levels. Some models also predict the existence of unobserved subatomic particles, which if exist, could cause a violation in the WEP at short distances. Short-range tests of gravity and the WEP are also instrumental in investigating possible proposed mechanisms that attempt to explain the accelerated expansion of the universe, generally attributed to Dark Energy. The weakness of the gravitational force makes measurement very difficult at small scales. Testing such a minimal force requires highly isolated experimental systems and precise measurement and control instrumentation. Moreover, a dedicated test of the WEP has not been performed below the millimeter scale. This talk will discuss the improved sensitivity that we expect to achieve in short-range gravity tests with respect to previous efforts that employ different experimental configurations.

1Supported by NSF award PHY-1065697
2undergraduate presenter
3undergraduate
4undergraduate

1:24PM F4.00003 Cosmological models with non-minimal derivative coupling1, SERGEY SUSHKOV, California State University, Fresno and Kazan Federal University, Kazan, Russia — We investigate cosmological scenarios with a non-minimal derivative coupling between the scalar field and the curvature, examining both the quintessence and the phantom cases with zero and constant potentials. In general, we find that the universe transits from one de Sitter solution to another, determined by the coupling parameters. Furthermore, according to the parameter choices and without the need for matter, we can obtain a Big Bang, an expanding universe with no beginning, a cosmological turnaround, an eternally contracting universe, a Big Crunch, a Big Rip avoidance and a cosmological bounce. This variety of behaviors reveals the capabilities of the present scenario.

1I appreciate Douglas Singleton and California State University Fresno for hospitality during the Fulbright scholarship visit.
DOUGLAS SINGLETON, RATBAY MYRZAKULOV — We examine the entropic picture of Newton’s second law for the case of circular motion. It is shown that one must make modifications to the derivation of \( F = ma \) due to a change in the effective Unruh temperature for circular motion. These modifications present a challenge to the entropic derivation of Newton’s second law, but also open up the possibility to experimentally test and constrain this model for large centripetal accelerations. (Phys. Lett. B 703 (2011) 516-518)

SUJOY MODAK, S.N. Bose National Centre for Basic Sciences — Conventional thermodynamics identify liquid to vapor phase transitions as a first order transition. Starting from the definition of the Gibbs free energy one obtains Clausius-Clapeyron equation which is satisfied for such a first order phase transition. Similarly for a second order phase transition Ehrenfest relations are satisfied. In this talk we implement these elementary ideas in black holes defined in anti-deSitter space. For charged as well as rotating black holes we show that there exists a phase transition from lower to higher mass (horizon-radius) branch which is not first order. We then derive and check the validity of Ehrenfest relations for these black holes. Our analysis proves that this is a second order phase transition. This result is also verified by using an alternative thermodynamic-state-space geometry approach.

I would be a visiting researcher at California State University, Fresno, at the time of attending the meeting.

STEVE WILBURN, DOUG SINGLETON, CSU Fresno — We compare the response function of an Unruh-DeWitt detector for different space-times and different vacua and show that there is a detailed violation of the equivalence principle. In particular comparing the response of an accelerating detector to a detector at rest in a Schwarzschild space-time we find that both detectors register thermal radiation, but for a given acceleration the fixed detector in the Schwarzschild space-time measures a higher temperature. This allows one to locally distinguish the two cases. As one approaches the horizon the two temperatures have the same limit so that the equivalence principle is restored at the horizon.

A recent proposal by Erik Verlinde claims that gravity should be viewed not as a fundamental force, but as an emergent thermodynamic phenomenon due to some yet undetermined microscopic theory. We present a challenge to this reformulation of gravity. Our claim is that a detailed derivation using Verlinde’s proposed theory fails to correctly give Newton’s laws or Einstein gravity.

A kilogram of mass contains \( \sim 10^{37} \) subatomic harmonic oscillators (e.g., quarks); decoherent superposition of their various quantum effects. A kilogram of mass contains \( \sim 10^{-27} \) subatomic harmonic oscillators (e.g., quarks); decoherent superposition of their momentum-driven (\( h/\Delta z \)) radiated waveforms provides an isotropic monotonically-decreasing space energy density. Spacetime response to the presence of this distributed energy manifests as the gravitational field in accord with the basic interpretation of general relativity: “energy curves spacetime.” Hypotheses put forward in this discussion are empirically testable with tabletop experiments.

A modified Newtonian dynamics and other relationships derived from the model are consistent quantitatively and functionally with a variety of observed astronomical data, some of which have been considered previously to be anomalous or based on dark matter.