2:00PM C1.00001 X-ray image and x-ray burst features of under-dense plasma produced in high-density gas jets on the Leopard Laser at UNR¹  
K.A. SCHULTZ, V.L. KANTSYREV, A.S. SAFRONOVA, A.J. ANDERSON, T.J. HUTCHINSON, P. WIEWIOR, V.V. SHLYAPTSEVA, M.E. WELLER, E.E. PETKOV, I.K. SHRESTHA, A. STAFFORD, M.C. COOPER, University of Nevada, Reno, NV 89557 USA — Results of Ar and Kr gas-puff experiments performed on the high-power Leopard laser at UNR are presented. The Leopard laser operated in two regimes: 350 fs, 40 TW pulse or 0.8 ns, 25 GW pulse with wavelength of 1.057 μm. A supersonic linear nozzle was compared with a cylindrical sub-sonic nozzle. Diagnostics included two sets of filtered Si-diodes, x-ray pinhole cameras, x-ray spectrometers, and PCDs. Specifically, x-ray images and structure of x-ray bursts are investigated and compared as a function of the linear or cylindrical gas jet, laser pulse duration, and target gas. Strong anisotropy with respect to laser beam polarization was observed in the x-ray output of the linear gas jet. Also, the addition of Kr to an Ar gas jet increased the intensity of the x-ray output compared to a pure Ar jet. The importance of analysis of x-ray burst features for better understanding the mechanisms of the laser energy to x-ray conversion efficiency and future research directions are discussed.

¹The work was supported by the Defense Threat Reduction Agency, Basic Research Award # HDTRA1-13-1-0033, to University of Nevada, Reno, and in part by DOE/NNSA Cooperative agreements DE-NA0001984 and DE-NA0002075.

2:12PM C1.00002 Positron Production Using a Laser-Wakefield Electron Source¹  
JACKSON WILLIAMS, UC Davis, LLNL, FELICIE ALBERT, HUI CHEN, LLNL, JAEBUM PARK, UC Davis, LLNL, BRAD POLLOCK, LLNL — Positron generation using laser-wakefield-accelerated electrons driven into a second mm-scale target was investigated using the Callisto Laser at the Jupiter Laser Facility at Lawrence Livermore National Laboratory. This technique [1] is in contrast to previous experiments that use direct laser-target interactions to create positron-electron pairs [2], and has the potential to make laser-produced positron sources widely available to smaller scale laboratories. Monte Carlo simulations show a collimated laser-wakefield electron beam produces a positron beam with a significantly larger divergence angle (>100 mrad) due to multiple small angle coulomb scattering, resulting in an emitted pair density of 10¹³ particles/cm². At the Callisto Laser, we did not observe a signal consistent with positrons. This could be due to a high noise environment and a large detection threshold.

¹This work was performed under the auspices of the U.S. Department of Energy (DOE) by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344 and funded by the LLNL LDRD program under tracking code 13-LW-076 and 12-ERD-062.

2:24PM C1.00003 ????ray production and transport in ultra-fast heated high Z matter¹  
RISHI PANDIT, YASUHIKO SENTOKU, University of Nevada Reno — Radiation transport code coupled with fully relativistic collisional Particle-in-Cell (PIC) code, PICLS, has been developed to study the transport of X-ray photons produced in laser-solid interaction. We have implemented the differential cross-section of emitted radiation with respect to frequency and emission angle of Bremsstrahlung and also the radiative damping to simulate high energy photons, ??ray, production and transport in ultra-intense laser – matter interactions. We discuss the laser energy dependence of the emission energy and the intensity dependence of the angular distribution of ??rays. By solving the transport of hard X-rays we find that high energy photons emitted by relativistic electrons are co-moving with the electrons and they are intensified continuously in the Bremsstrahlung process. As a result the ??rays have the signature of the fast electrons’ temporal and spatial distribution. We also calculate the number of pairs by solving the Bethe-Heitler cross-section in the radiation transport simulation. Comparing the details of ??rays via Bremsstrahlung and radiative damping with varying laser intensities, we will discuss the laser parameters and the target conditions (material) to increase the ??ray yields.

¹Supported by US DOE DE-SC0008827.

2:36PM C1.00004 Study of Hard X-rays and Electron Beams on 1.7 MA Z-pinch and Laser Plasma Experiments¹  
I. SHRESTHA, V.L. KANTSYREV, A.S. SAFRONOVA, V.V. SHLYAPTSEVA, K.A. SCHULTZ, M.E. WELLER, A. STAFFORD, E.E. PETKOV, M.C. COOPER, P. WIEWIOR, University of Nevada, Reno, NV — The studies of Hard X-ray (HXR) emission and electron beam generation in Z-pinch and laser plasmas are very important for development of sources of K-shell and L-shell radiation and Inertial Confinement Fusion (ICF) research. The configuration as well as elemental composition of Z-pinch loads (planar and cylindrical wire arrays) or laser targets (gas-puff) is an important feature for both total hard X-ray radiation (HXR) and electron beam generation. There is variation of HXR and electron beam generations when testing different wire loads on Z-pinch generator and in the interaction of laser with different gases (Ar, Kr and mixture of Ar/Kr). Also for laser plasma experiments, the HXR yield and electron beam depends on anisotropy with respect to laser beam polarization. The comparative study of HXR yield and electron beam generation in both experiments will be discussed.

¹The work was supported by the DOE/NNSA cooperative agreement DE-NA0001984, and in part by DE-NA0002075, and the DTRA grant HDTRA1-13-1-0033.

2:48PM C1.00005 Formation of Plasma from Thick Metal Pulsed with Multi-MegaGauss Magnetic Field¹  
B.S. BAUER, K.C. YATES, S. FUELLING, V.V. IVANOV, I.R. LINDEMUTH, R.E. SIEMON, R.L. RICHARDS, J.S. BACSTER, R.C. SMITH, B.S. BAUER, K.C. YATES, S. FUELLING, V.V. IVANOV, I.R. LINDEMUTH, R.E. SIEMON, SANDIA NATIONAL LABORATORIES, SANDIA NATIONAL LABORATORIES, SANDIA NATIONAL LABORATORIES, R.S. BAUER, Stanford University — Understanding the evolution of ohmically heated conductors is exceptionally important for basic physics and applications (e.g., fusion energy). The thermal ionization of the surface of metal rods with radii larger than the magnetic skin depth is being investigated with well-characterized experiments and detailed numerical modeling. Metal rods of initial diameter 0.50-2.00 mm are pulsed to 1.0 MA peak current in 100 ns. The rod material [Al-6061, Al-1100, Cu-101, Cu-145, Ni-200, or Ti-Grade-II] and surface finish (finely or coarsely machined, electropolished or not) are varied. Time-resolved imaging, radiometry, spectroscopy, and laser shadowgraphy track the evolution of the rod surface plasma when the surface reaches a critical value (e.g., 2.2 MG for Al-6061). At the threshold, the optical emission from the surface is non-uniform, showing discrete bright points. Then plasma filaments form, mainly in the direction of the current, until the surface emission is quite uniform. Radiation-MHD simulations with the numerical code MHRDR can reproduce macroscopic features of the data on aluminum by using certain choices of models for resistivity, equation of state, other transport coefficients, and radiation opacities.

¹Work partially supported by Sandia National Laboratories POI1457882 and by DOE grants DE-SC0008824 and DE-FC52-06NA27616.
3:00PM C1.00006 Improvements to a novel photoionized plasma experiment and calculations at the Z facility, T.E. LOCKARD, D.C. MAYES, T. DURMAZ, R.C. MANCINI, University of Nevada-Reno, G. LOISEL, J.E. BAILEY, G.A. ROCHAII, Sandia National Laboratories, D.A. LIEDAHL, R.F. HEETER, Lawrence Livermore National Laboratory — A large scale effort has been made to understand and explain photoionized plasmas in astrophysical observations made by X-ray orbiting telescopes like Chandra and XMM-Newton. The atomic kinetics and radiation transfer of these plasmas are driven by a large flux of high energy photons required by the photoionization process. While these sources of high flux drivers are more abundantly found in celestial mediums, the difficulty comes into play when trying to create such a source in a controlled laboratory environment. This has been part of the crux and hindrance of the progress in studying this fundamental aspect of nature. Luckily, with recent developments and utilization of pulsed power technologies the Z machine at Sandia National Laboratory helps alleviate this obstruction. To understand the complex environment where a collapsing wire array is used to create the intense source of X-rays required to produce a photoionized plasma, a large array of geometric, radiation-hydrodynamic and atomic kinetic codes help to give insight into the X-ray environment and plasma hydrodynamics of the system. These calculations complement experimental data attained to give a more complete understanding and deepen our knowledge of the competing processes in laboratory photoionized plasmas.

3:12PM C1.00007 Renovated Compact Z-pinch Facility “Sparky” and Development and Tests of Focusing Crystal X-ray Spectrometers1, M.C. COOPER, V.L. KANTSYREV, A.S. SAFRONOVA, I.K. SHRESTHA, K.A. SCHULTZ, V.V. SHLYAPTESEVA, M.E. WELLER, A. STAFFORD, E.E. PETKOV, M.T. SCHMIDT-PETERSEN, M.Y. LORANCE, W. CLINE, C. DAVIDSON, University of Nevada, Reno, NV 89557 USA — The compact x-ray/EUV facility “Sparky” at the UNR Physics Department’s Plasma Physics and Diagnostics Laboratory (PPDL) was renovated to obtain high density and temperature plasmas with gas-puff z-pinch experiments. The renovated facility will be used for plasma dynamics and radiation studies, x-ray spectroscopic research, benchmarking of theoretical codes, calibration of x-ray and diagnostic instrumentation, and education and training of UNR physics students. The SCREAMER code was used to model the device’s circuit and predicted a 200-230 kA current pulse with a rise time of 600 ns. To develop new diagnostics, a vertical focusing Hamos type spectrometer with a cylindrically bent mica crystal and a horizontal focusing Johann type spectrometer with a cylindrically bent Si crystal were designed for x-ray spectroscopy of the gas jets. Both spectrometers were tested with the NTF Leopard fs laser and captured x-ray spectra from laser interactions with Ar and Kr gas-puff jets from a supersonic nozzle.

1The work was supported by the DOE/NNSA cooperative agreement DE-NA0001984, and in part by DE-NA0002075, and the DTRA grant HDTRA1-13-1-0033.

3:24PM C1.00008 Plasma Formation and Evolution on the Surface of Aluminum, Copper, Titanium and Nickel Driven by a Mega-Ampere Current1, KEVIN YATES, BRUNO BAUER, STEPHAN FUELLING, VLADIMIR IVANOV, AUSTIN ANDERSON, JEFFREY MEI, TREVOR HUTCHINSON, University of Nevada, Reno, THOMAS AWE, Sandia National Laboratory, REBECCA BAUER, Stanford University — An important question for both fundamental science as well as applications is what state of matter is produced when a metal conductor is pulsed by an intense current. Aluminum, copper, titanium and nickel mm-diameter rods have been driven by a 1-MA, 100-ns current pulse. The intense current produces megagauss surface magnetic fields that diffuse into the load, ohmically heating the metal to temperatures that cause multiple phase changes. Because the radius is much thicker than the skin depth, the magnetic field reaches a much higher value than around a thin-wire load. With the novel “barbell” load design, plasma formation in the region of interest due to contact arcing or electron avalanche is avoided, allowing for the study of ohmically heated loads. Work presented here will show first evidence of a magnetic field threshold for plasma formation in titanium, copper alloys 145 and 101, nickel alloy 200, and compare with previous work done with aluminum. Copper alloys 101 and 145, aluminum 6061, titanium grade II, and nickel alloy 200 form plasma when the surface magnetic field reaches 3.9, 3.2, 2.2, 2.2, and 2.5 megagauss, respectively.

1Work partially supported by DOE grants DE-SC0008824, DE-FCS2-06NA27616 and Sandia National Laboratories POI1457882.

3:36PM C1.00009 Comparison of Radiative Properties of Wire Arrays and X-Pinches on the 1.7 MA Zebra Generator1, A. STAFFORD, A.S. SAFRONOVA, V.L. KANTSYREV, M.E. WELLER, I. SHRESTHA, V.V. SHLYAPTESEVA, University of Nevada, Reno, NV 89557, USA, A.S. CHUVATIN, Laboratoire de Physique des Plasmas (CNRS/Ecole Polytechnique/UPMC/Université Paris Sud), Ecole Polytechnique, 91128 Palaiseau, France — The Zebra generator, a pulse power device, of 1 MA and 100 ns rise time was upgraded with a Load Current Multiplier (LCM) to implode wire loads at higher current of 1.7 MA. Radiative properties of two different wire load configurations, Cylindrical Wire Arrays (CWA) and X-Pinches, are considered and compared. The CWA is 6 Ni-60 wires, mostly Cu, arranged in a cylindrical pattern. The CWA has a total radiation yield of 16 kJ from a column like source including a precursor plasma column prior to the implosion of the wires. The X-pinch was composed of a Ti alloy (6% Al, 4% V). The total radiation yield was 19 kJ and was primarily a point like source with a higher density than the CWAs. Additionally K-shell Al radiated unexpectedly strong in X-pinches for its low percentage of the material. Plasma properties will be described using pinhole images to display the structure and spectra to estimate electron temperatures and densities.

1This work was supported by NNSA under DOE Cooperative Agreement DE-NA0001984 and in part by DE-NA0002075.

Friday, October 24, 2014 2:00PM - 3:36PM — Session C2 Atomic, Molecular and Optical Physics —

2:00PM C2.00001 Stokes' theorem, gauge symmetry and the time-dependent Aharonov-Bohm effect, JAMES MACDOUGALL, DOUGLAS SINGLETON, California State University, Fresno — Stokes' theorem is investigated in the context of the time-dependent Aharonov-Bohm effect — the two-slit quantum interference experiment with a time varying solenoid between the slits. The time varying solenoid produces an electric field which leads to an additional phase shift which is found to exactly cancel the time-dependent part of the usual magnetic Aharonov-Bohm phase shift. This electric field arises from a combination of a non-single valued scalar potential and/or a 3-vector potential. The gauge transformation which leads to the scalar and 3-vector potentials for the electric field is non-single valued. This feature is connected with the non-simply connected topology of the Aharonov-Bohm set-up. The non-single valued nature of the gauge transformation function has interesting consequences for the 4-dimensional Stokes' theorem for the time-dependent Aharonov-Bohm effect. An experimental test of these conclusions is proposed.
In this talk, we will discuss the phenomenon of the Quantum Cheshire Cat. Atomic magnetic resonances are tuned with a magnetic field. Micro-mechanical resonators provide single-spin sensitivity and sub-micron spatial resolution; these micro resonators can be used to study decoherence and quantum control when applied to probe ultra-cold atoms. In the future, we will explore the boundary between quantum microscopic phenomena and macroscopic systems by coupling a quantum system with well-understood coherence properties with a macroscopic system. Micro-mechanical resonators offer extremely high sensitivity and potentially long spin coherence times at short range predicted by several theories beyond the Standard model— including supersymmetry and string theory. In our experiment, we use an optically levitated and cooled dielectric nanosphere in vacuum as a micromechanical sensor which can have extremely high sensitivity and with rubidium densities of $10^{17}$ cm$^{-3}$. As such, they are a promising environment for quantum information experiments, as well as sensors such as magnetometers. We will report on measurements of spin lifetimes and discuss our future endeavors. *weinstein@physics.unr.edu


3:24PM C2.00008 Modeling the electron as a circulating charged photon. RICHARD GAUTHIER¹, Santa Rosa Junior College — A new semi-classical model of the electron shows a number of relativistic and quantum mechanical features of the electron by modeling the electron as a circulating charged photon. A charged photon and its light-speed helical trajectory are a solution to the relativistic electron’s energy-momentum equation. This charged photon quantitatively resembles the light-speed electron described by Dirac. The electron’s velocity is the longitudinal component of the photon’s helically circulating velocity. The electron’s relativistic energy is the charged photon’s energy. The electron’s relativistic momentum is the longitudinal component of the charged photon’s helically circulating momentum. At any electron speed, the charged photon has an internally circulating transverse momentum mc, which at the helical energy is the charged photon’s energy. The electron’s relativistic momentum is one-half of the pre-QED magnetic moment predicted by the Dirac equation for the relativistic electron.

¹Website www.superluminalquantum.org

Friday, October 24, 2014 2:00PM - 3:48PM – Session C3 Condensed Matter and Material Science  JCSU 323 - Sergey Savrasov, University of California, Davis

2:00PM C3.00001 Suspended Molybdenum Disulfide Field Effect Transistors. FENGLIN WANG, PETER STEPANOV, MASON GRAY, CHUN NING LAU, Department of Physics and Astronomy, University of California, Riverside — We fabricate suspended molybdenum disulfide (MoS₂) field effect transistors (FET) devices and develop an effective gas annealing technique that significantly improves device quality and increases conductance by 3-4 orders of magnitude. Mobility of the suspended devices ranges from 0.01 to 10 cm²/Vs before annealing, and 0.5 to 85 cm²/Vs after annealing. Temperature dependence measurements reveal two transport mechanisms: electron-phonon scattering at high temperatures and thermal activation over a gate-tunable barrier height at low temperatures. Our results suggest that transport in these devices is not limited by the substrates, but likely by defects, charge impurities and/or Schottky barriers at the metal-MoS₂ interfaces. Finally, this suspended MoS₂ device structure provides a versatile platform for other research areas, such as thermal, optical and mechanical studies.

2:12PM C3.00002 Growth of Au on Ge(110). ALEX DORSETT, BRET STENGER, MARSHALL VAN ZUILL, CATRIANA PAW U², SHIRLEY CHIANG, University of California Davis — The clean Ge(110) surface is studied using Scanning Tunneling Microscopy (STM) to analyze potential sites for growth. The surface structure and growth mechanism of Au on Ge(110) is characterized with Low Energy Electron Microscopy (LEEM). Au is dosed at room temperature with approximately 0.5 monolayers (ML) of coverage. The temperature is increased up to 800°C when the sample is imaged by LEEM. As the temperature increases, the Au islands form into much larger one-dimensional structures, with all the islands growing along the same direction. This behavior is similar to that previously observed for Ag on Ge(110)³ although the scale of the islands differs. As the temperature decreases, the island behavior is also studied and reveals rapid island contractions which leave traces on the Ge(110) surface.

¹Funding for A. Dorsett from NSF REU grant PHY-1263201.
²Present Address: Davis Senior High School

2:24PM C3.00003 Optical Conductivity Studies of Small Polaron Hopping in Sm₁₋ₓSrₓTiO₃ Epitaxial Films. WILLIAM FLAHERTY, CLAYTON JACKSON, SANTOSH RAGHAVAN, ADAM HAUSER, STRANGE LAW, BRANDON ISAAC, SUSANNE STEMMER, S. JAMES ALLEN, UC Santa Barbara, EXEDE MURI TEAM. — We present our findings in the optical conductivity in a doping-controlled metal-to-Mott-insulator transition. These samples, grown using hybrid MBE, span the transition from the Mott insulator Sm₂TiO₅ to metallic, lightly-doped SrTiO₃. Zhou and Goodenough have studied a wide range of rare earth titanates and found that Sm₂TiO₅ has thermally activated transport. We plan to measure the optical conductivity of doped samples to determine the conduction mechanism. Using FTIR spectroscopy, we extract the optical conductivity in the 0.06-2.5 eV range. If conduction in Sm₁₋ₓSrₓTiO₃ is due to small polarons, it will have a distinct optical conductivity feature, related to the DC transport, as described by David Elin. Alternatively, conduction could be due to variable-range hopping between defects. Further, from the combination of DC and optical conductivity, we can also test the prediction of Yee and Balents that the metal-to-insulator transition is first-order with percolative phase separation between metallic and localized regions. Such a sample would have a distinct Drude tail plus polaron contributions to its conductivity.

¹Extreme Electron Concentration Oxide Devices, Supported by ONR EXEDE MURI, ONR N00014-12-0976

2:36PM C3.00004 Identifying Topological Order in the Shastry-Sutherland Model via Entanglement Entropy. DAVID RONQUILLO, MICHAEL PETERSON, Cal State Univ- Long Beach — It is known that for a topologically ordered state the area law for the entanglement entropy shows a negative universal additive constant contribution, −γ, called the topological entanglement entropy. We theoretically studied the entanglement entropy of the two-dimensional Shastry-Sutherland quantum antiferromagnet using exact diagonalization on clusters of 16 and 24 spins. By utilizing the Kitaev-Preskill construction [A. Kitaev and J. Preskill, Phys. Rev. Lett. 96, 110404 (2006)] we extract a finite topological term, −γ, in the region of bond-strength parameter space corresponding to high geometrical frustration. Thus, we provide strong evidence for the existence of an exotic topologically ordered state and shed light on the nature of this model’s strongly frustrated, and long controversial, intermediate phase.
2:48PM C3.00005 Cascading Proximity Effects in Inhomogeneous Superconductor-Ferromagnetic Structures, THOMAS BAKER, Department of Physics & Astronomy, University of California, Irvine, CA 92697, ADAM RICHIE-HALFORD, OVIDIU ICREVERZI, ANDREAS BILL, Department of Physics & Astronomy, California State University, Long Beach, CA 90840 — When a superconductor is placed near another material, the whole system becomes superconducting by proximity. Paired correlations with a projection on the quantization axis of zero have a shorter coherence length than those with ±1 on the quantization axis. We show that the ±1 projections can generate short range components deep inside a magnetic layer in the middle region of five mutually perpendicular ferromagnets as well as an exchange spring system [1,2]. Measurable consequences including the characteristic signature of short range correlations in the Josephson current of a wide layer and a new type of f(−τ) transition will be discussed.


We gratefully acknowledge support from the Achievement Rewards for College Scientists, National Science Foundation DMR-0907242, and the CSU Long Beach Graduate Research Fellowship

Also Department of Physics & Astronomy, California State University, Long Beach, CA 90840

3:00PM C3.00006 Odd-Triplet Superconductivity in SmCo/Py/Nb Thin Films, SAMUEL HEDGES, MIKAEL SEMAAN, JYEONG GU, Cal State Univ-Long Beach — An s-wave superconductor in close proximity to a nonhomogeneous magnetic field will have the singlet component of the superconducting condensate converted to the odd-triplet component at the superconductor/ferromagnet (S/F) interface. The odd-triplet component can penetrate into the ferromagnet over long distances and is insensitive to the ferromagnet’s exchange field. Using an exchange-spring system consisting of SmCo/Py, the noncollinearity of the field can be varied by adjusting the direction and strength of an applied external field. Nb/Py/SmCo thin films were sputtered onto a silicon substrate using D.C. magnetron sputtering. The resistance and superconducting critical temperature were measured as functions of the applied field strength, direction, temperature, and thickness of the layers. The resistance was found to vary non-monotonically with increasing noncollinearity, which cannot be explained by the proximity effect alone. The behavior could be due to new proximity effects involving exchange spring systems that display complicated magnetic switching behavior.

1This project is supported in part by the CSULB Summer Student Research Assistantship.

3:12PM C3.00007 Photoinduced doping in heterostructures of graphene and boron nitride, SALMAN KAHN, JAIRO VELASCO JR, LONG JU, EDWIN HWANG, CASEY NOSIGLIA, HSIN ZON TSAI, Department of Physics, University of California, Berkeley, WEI YANG, Beijing National Laboratory for Condensed Matter Physics and Institute of Physics, TAKASHI TANIGUCHI, KENJI WATANABE, Advanced Materials Laboratory, National Institute for Materials Science, DILLON WONG, JUWON LEE, YUANBO ZHANG, Department of Physics, University of California, Berkeley, GUANGYU ZHANG, Beijing National Laboratory for Condensed Matter Physics and Institute of Physics, MICHAEL CROMMIE, ALEX ZETTL, FENG WANG, Department of Physics, University of California, Berkeley — Van der Waals heterostructures (VDH) provide an exciting new platform for materials engineering, where a variety of layered materials with different electrical, optical and mechanical responses can be stacked together to enable new physics and novel functionalities. To create various VDH, we have employed a “stamping transfer” in which two layered materials are exfoliated on separate substrates and then stamped onto each other. Several distinct VDH structures have been realized and characterized through scanned probe and optical measurement schemes. I will discuss recent progress made on these efforts, with an emphasis on optoelectronic measurements of a Graphene/Boron Nitride VDH.

3:24PM C3.00008 Growing and Characterizing 2D Silica Bilayers on Graphene Epitaxially Grown on Ruthenium(0001)/Sapphire, JEFF GUEVARA, KENNETH GANEZER, California State University, Dominguez Hills, ERIC ALTMAN, Yale University — Two-dimensional (2D) silica (SiO$_2$) glass bilayers are a new form of SiO$_2$ that is exactly 2 atoms thick with no dangling bonds. Since 2D silica bilayers have no dangling bonds, it is expected to be a van der Waals material with no detectable covalent bonding. Two-dimensional silica can have many applications in layered graphene electronics and dielectric layers in atomically thin transistors, along with applications as membranes that allow only molecules smaller than a specific size to fit through and where the atomic thickness promises unprecedented throughput. The goal of this research is to determine the optimal conditions for growing a 2D silica bilayer on a uniform graphene monolayer and to also study its characteristics and intrinsic properties when removed from all substrates. The first step is to determine the optimal growth conditions for growing a uniform graphene monolayer on epitaxial ruthenium (0001) on c-plane sapphire. The next step is to determine the optimal growth conditions of 2D silica bilayers on graphene. The 2D silica will then be isolated from the substrate so that its characteristics and intrinsic properties can be studied using Raman spectroscopy, transmission electron microscopy, scanning transmission electron microscopy, and electron energy loss and X-ray emission spectroscopy.

1Research Mentor

3:36PM C3.00009 The Log-Lin Metric for Generic Responses in Logarithmic Structures, ANTONY BOURDILLON, Retired — The Log-Lin metric is a keystone on the arch that joins experimental quasicrystal data with ideal periodic wave onto a logarithmic grid [3]. The metric, now systematically analyzed and simulated, enables measurement from the atomic scale to high order superclusters. The metric is analytically derived from a mathematical constant ($\pi$) that converts the geometric series base tau to the same series base pi. The factor applies to physical clusters of extremely dense, binary, hard-sphere, icosahedral, unit cells.


Friday, October 24, 2014 2:00PM - 3:00PM – Session C4 Education, Atmospheric Science and Other JCSU 324 - Melodi Rodrigue, University of Nevada, Reno
2:00PM C4.00001 Summer as a Student Teacher and Researcher Fellow at the Lawrence Livermore National Laboratory E.B.I.T. Facility1, DOMINIQUE DAVENTPORT, GRECIA RAMOS, HEATHER BROWN, Lawrence Livermore National Laboratory — We will briefly describe the STAR (Student Teacher and Researcher) program as well as the research we participated in as STAR Fellows at Lawrence Livermore National Lab E.B.I.T. facility. The STAR Program allows pre-service teachers to intern at research facilities while attending weekly courses to review teaching standards. The E.B.I.T. or Electron Beam Ion Trap, is an instrument that allows us to probe into electron transitions of complex highly charged ions by use of a mono-energetic beam of electrons. X-rays are emitted from the electron excitations in these highly charged ions and can be detected by an assortment of X-ray spectrometers. Over the summer, we were able to characterize a High Resolution Spherically Bent Crystal Spectrometer for use at the Atomic Weapons Establishment and measure transition energies of highly charged Aluminum ions for the planned Astro-H mission.

1With the support of the STAR program and Lawrence Livermore National Lab.

2:12PM C4.00002 Physics Instruction at the Davidson Academy of Nevada, BRETT GUISTI, Davidson Academy — There are three physics offerings at the Davidson Academy: 1) Physical Science - a middle school class which focuses on basic mechanics. 2) Physics - a high school class covering mechanics, waves, optics, thermodynamics, fluids, and special relativity. 3) Advanced Physics - a calculus-based course with a semester each of mechanics and electricity and magnetism. Basic concepts guiding all classes include conceptual understanding, computational practice, and comprehensive experiences. For the first time this year, the high school physics class is being taught using a “Flipped Classroom” approach where students watch videos of lectures at home and use class time to work on problem solving and labs. An emphasis on special relativity drawing heavily from the materials in Brian Greene’s online World Science U course will also be added to the physics curriculum this year.

2:24PM C4.00003 From Electrons Paired to Electric Power Delivered – A Personal Journey in Physics Research and Applications at IBM, EPRI, and Beyond, PAUL GRANT, W2AGZ Technologies — This talk will reprise a personal journey by the speaker in industrial and applied physics, commencing with his employment by IBM at age 17 in the early 1950s, and continuing through his corporate sponsored undergraduate and graduate years at Clarkson and Harvard Universities, followed by a 40-year career focusing on the properties of conducting and superconducting organic and polymeric materials, employing a wide variety of experimental and computational techniques, first at the IBM Almaden Research Center, and later with the Electric Power Research Institute. Now in “retirement,” he pursues and publishes his computational (DFT) studies on “proxy” copper monoxide structures in hopes of clarifying the pairing mechanism underlying high temperature superconductivity. In summary, the speaker’s career in applied physics demonstrates one can combine publishing a record three PRLs in one month with crawling around in substations alongside utility lineman helping install superconducting cables.

2:36PM C4.00004 Assessment of Wildfire Smoke Plume Impacts in Reno, NV During the 2013 California Fires, SANDRA LORIA-SALAZAR, HEATHER ARNOTT, UNR, ATMOSPHERIC SCIENCE TEAM — The study of aerosol pollution transport and optical properties in the western U.S. is a challenge due to the complex terrain, bright surfaces, presence of anthropogenic and biogenic emissions, secondary organic aerosol formation, and smoke from wild fires. Here, we analyze data from August 2013 as a case study for wildfire smoke plumes in California and Nevada. During this time period, northern California was impacted by large wildfire fires known as the American and Yosemite Rim fires. The aim of the present work is to investigate the fire plume behavior and to understand the phenomenon at different levels. We perform routine monitoring of aerosol at the top of the atmosphere and aerosol optical properties from AERONET located in Reno Nevada. The multispectral photoacoustic instruments and reciprocal nephelometers located in Reno support the estimation of Approximated Aerosol Height (AOH). Preliminary results show that surface and columnar measurements agreed when the fire signal was high and the smoke plume stayed at low levels. However, there is significant aerosol pollution aloft due to increased mixing in the atmosphere from complex terrain and fire plume dynamics complicating the ability of remotely-sensed near-surface aerosol pollution from satellites.

2:48PM C4.00005 Thermal Infrared Radiative Forcing by Atmospheric Aerosol, NARAYAN ADHIKARI, WILLIAM P. ARNOTT, University of Nevada Reno — The radiative effect of aerosol in the longwave (LW) spectral domain is usually considered negligible and is often not included in climate models. We have demonstrated that both the bottom of the atmosphere (BOA) and top of the atmosphere (TOA) LW radiative forcing (RF) due to coarse mode aerosol, associated with large airborne mineral dust particles, and that due to fine mode aerosols, mainly associated with small biomass-burning smoke particles, are significant and positive. The LW RF produces heating at the Earth’s surface, counterbalancing the well-known cooling effect associated with aerosol RF in the shortwave (SW) spectral region. Also, the aerosol LW forcings on typical conditions in Reno, NV, are comparable in magnitude to the enhancement due to increase in CO2 concentration in the Earth’s atmosphere since the preindustrial era of 1750. These results underscore that the importance for inclusion of accurate aerosol LW RF in atmospheric radiative transfer in general and climate models in particular.

4:15PM - 4:15PM – Session D1 Poster Session – JCSU 320 –

D1.00001 Literary Analysis of Titan’s Atmosphere in Particular Tholin Formation, BRANDON LEETS, University of Nevada, Reno — Saturn’s moon, Titan, has been an intriguing area of study to the astronomical community since its discovery. Titan has a thick atmosphere unlike any other moon in the solar system. One of the biggest discoveries in Titan’s atmosphere was the presence of large particles known as Tholins. The production of these larger particles begins in the upper atmosphere and as they accumulate mass they descend down to the surface of Titan. This precipitation causes a haze layer to form over the moon, making it difficult to see and understand the surface. This process is believed to be similar to what may have happened in Earth’s early atmosphere. This haze layer has a greenhouse and anti-greenhouse effect. It has been found that seasonal changes in wind and temperature affects the rate of production and type of Tholins. Also strong winds along the equator prevent molecules from mixing in the polar regions of Titan. These winds can reach upwards of 70 m/s and occur mostly during seasonal changes. By carefully adjusting models to include current knowledge regarding C/N ratios. Pressure, temperature, and ignition sources it will be possible to gain a better understanding of Titan’s atmosphere and in turn the evolution of Earth’s atmosphere.

D1.00002 Mechanical Manipulation of Atomic Spin, JOSE VALENCIA, CRIS MONTOYA, ANDREW GERACI, University of Nevada, Reno — The atomic spin of cold atoms can be measured and manipulated through micro-mechanical resonators, e.g. cantilevers. This method could allow single-spin sensitivity and sub-micron spatial resolution enabling new studies of decoherence and quantum control. We describe our experiments that manipulates the spin of trapped, cold Rb atoms using magnetic material on a cantilever.
D1.00003 Design of Superconducting Magnetic Shielding for an Axion Detector, JORDAN DARGERT, SUYESH ROYU, ANDREW GERACI, University of Nevada, Reno, UNIVERSITY OF NEVADA, RENO COLLABORATION, PERIMETER INSTITUTE FOR THEORETICAL PHYSICS, WATERLOO COLLABORATION, INDIANA UNIVERSITY COLLABORATION — A new experiment has recently been proposed [1] that can detect the Peccei-Quinn (PQ) axion, a hypothetical particle whose detection could explain Dark Matter’s existence and the smallness of the neutron electric dipole moment. Using a new form of Nuclear Magnetic Resonance, the method can probe well into the PQ axion decay range. Additionally it does not rely on cosmological assumptions. In this poster, we will discuss the design of a superconducting magnetic shield that is required for reducing background magnetic fields in the experiment.


D1.00004 Investigation of shock damage from x-pinch wire loads1, BEN HAMMEL, TIM DARLING, University of Nevada at Reno — In x-pinch experiments on the Nevada Terawatt Facility’s 1-MA pulsed power machine (Zebra), significant damage of the anode has been observed. Post shot analysis shows scabbing at the free-surface as well as multiple spall layers. This damage is a result of a strong shock - generated by several factors: (1) a rapid deposition of energy from ballistic electrons impacting the sample, resulting in ablation of material; (2) ablation from the impact of a high Mach-number plasma jet - formed from the implosion of the x-pinch wire array; (3) magnetic pressure resulting from the electrical current flowing across the surface of our target, perpendicular to the induced magnetic field. We are currently performing experiments to characterize the mechanisms responsible for this shock generation, and investigating the material state as a result of shock-compression of this type. Free-surface velocities as high as 2 km/s in 2, 3, and 4-mm-thick Copper targets have been recorded using a Line-VISAR (Velocity Interferometer System for Any reflector). The time-profile of the drive is characterized by the hard x-ray (100 keV -1 MeV) emission resulting from the bremsstrahlung radiation due to the impact of electrons with the target. We see that damage is a strong function of x-pinch wire material, and not correlated to the linear mass of the x-pinch load. The feasibility of using this drive type as a method for shock-physics experiments is also discussed.

1Research at UNR was funded by the U.S. DOE under grant number DE-NA0002075

D1.00005 Introduction of a novel method for manufacturing ultrathin silicon ribbon, HYUNG WOO CHOI, MOHAMMED DANYAN, DHANESH CHANDRA, GHAHASS JABBOUR1, Univ of Nevada - Reno — We report on a new and quick (ca. 1 hour!) route for fabricating ultrathin silicon substrate directly from in-situ molten silicon by an inductor heater spin-melt based technique. Structural and compositional properties of silicon substrate indicate a pure (without SiO2, SiC formation) and polycrystalline nature of the fabricated ribbon. Compared to conventional methods for manufacturing thin silicon substrates, including edge stabilized growth (ESG), edge-defined film-fed growth (EFG), ribbon growth on substrate (RGS), etc., our development shows significant thickness reduction. In this regard, we were able to obtain unprecedented 20 μm thick samples, without any supporting carrier. We anticipate our high-speed low cost fabrication approach of silicon substrates to have a great potential in photovoltaic and semiconductor industry.

1Director of Renewable Energy Center, University of Nevada, Reno

D1.00006 SiN thin films for fabrication of flexible organic solar cell with enhanced stability, HYUNG WOO CHOI, Univ of Nevada - Reno, BARRY O’BRIAN, YONG KYUN LEE, JEAYOUNG CHOI, Arizona State University, GHAHASS JABBOUR1, Univ of Nevada - Reno — We demonstrate an enhanced stability of organic solar cells (OSC) through the incorporation of a thin silicon nitride (SiN) layer (ca. 300 nm) as a diffusion barrier of oxygen and water. Chemical vapor deposition (CVD) at 150 °C was used to deposit the SiN on flexible substrates of polyelelyme naphthalate (PEN) and polyethylene terephthlate (PET). Upon device testing, OSCs with silicon nitride barrier layer showed three orders of magnitude improved performance when exposed to water vapor, as compared to OSCs without SiN. Un-encapsulated devices with SiN film showed only a 20% decrease in power conversion efficiency after exposure to air for more than a month! On the other hand, OSCs without the SiN layer failed upon exposure to air for 15 days. Detailed fabrication, testing and characterization of engineered devices will be given.

1Director of Renewable Energy Center, University of Nevada, Reno

D1.00007 Observation of long-lived room temperature phosphorescence from exciplex in organic metal-free materials, TIANLEI ZHOU, Univ of Nevada - Reno, YUE WANG, Jilin University, China, GHAHASS JABBOUR, Univ of Nevada - Reno — Long-lived room temperature phosphorescence (RTP) from metal-free organic material system is very rare because the intersystem crossing rate in organic molecules is very small, and long-lived excited triplet states are easily quenched by oxygen and thermal perturbations. This research presents an intense long-lived RTP from exciplex formation, for a given organic materials system, in the absence of phosphorescence protector or stabilizer. Our experimental observation indicates that such exciplex is resistant to oxygen quenching and can be obtained easily by grinding the powders of given materials. Our approach demonstrates, for the first time to our knowledge, a low cost and efficient route to obtaining long-lived RTP in organic materials.

D1.00008 Laser Produced Neutrons and Isotope Activation at the Nevada Terawatt Facility1, ZEPHIR MCCORMICK, OLEKSANDR CHALYY, TIMOTHY DARLING, BENJAMIN HAMMEL, JEREMY IRATCABAL, ERIK MCKEE, PIOTR WIEWOR, AARON COVINGTON, University of Nevada, Reno - Physics Department — Preliminary feasibility studies of pulsed-power based neutron and isotope production is underway at the Nevada Terawatt Facility. Both the Leopard Laser and Zebra Z-pinch systems have been utilized for neutron and isotope production studies. Preliminary experiments on Leopard have successfully produced ~1016 neutrons per laser shot using 5 μm Au foil targets with 6 mm of LiF as a converter material. Alternate materials for both thin foil targets and converters are being investigated, along with modifications to laser targets, in an effort to improve neutron and isotope yields from NTF systems. Preliminary experiments on Zebra Z-pinch have successfully produced radioactive isotopes that decay via the β+ pathway. It is believed that the parent isotopes originate in the shot hardware (Type 304 SST) used to support deuterium treated Pd wire loads. The radioactive decay of the daughter isotopes is measured using a standard nuclear coincidence detection technique. Follow on experiments are being designed to increase yields in laser and Z-pinch shots and further explore the mechanisms governing isotope production in Z-pinch shots.

1Research at UNR was funded by the U.S. DOE under grant number DE-NA0002075.
D1.00009 Spectroscopic Analysis of K- and L-Shell Radiation from Gas-Puff Jet Experiments on the UNR Leopard Laser¹. E.E. PETKOV, A.S. SAFRONOVA, V.L. KANTSIREV, J.J. MOSCHELLA, P. WIEVIOR, V.V. SHLYAPSTEVA, M.C. COOPER, M.E. WELLER, I.K. SHRESTHA, A. STAFFORD, K.A. SCHULTZ, Univ of Nevada - Reno — The study of cluster formation in gas-puff jet experiments and the x-ray emission from them under fs and ns laser impulses is of interest as there are many applications in physics (x-ray backlighting, lithography, high-harmonic generation, etc.) We present spectroscopic analysis of K- and L-shell radiation from Ar and Kr gas-puff jet experiments performed on the high-power Leopard Laser at UNR. To enhance our theoretical understanding of this radiation, and to help with identification of spectral lines, non-local thermodynamic equilibrium (non-LTE) kinetic models of Ar and Kr have been developed. Approximate temperature and density parameters have been identified in experiments with pure Kr, pure Ar, and Kr/Ar mixtures. Further work is discussed.

¹This work was supported by the Defense Threat Reduction Agency, Basic Research Award # HDTRA1-13-1-0033, to the University of Nevada, Reno, and in part by the DOE/NNSA Cooperative Agreements DE-NA0001984 and DE-NA0002075.

D1.00010 Spatial distribution of Ti-tracer in OMEGA implosions. T. JOSHI, R. MANCINI, D. MAYES, University of Nevada, Reno, T. NAGAYAMA, Sandia National Laboratories, R. TOMMASINI, Lawrence Livermore National Laboratory, J. DELETTREZ, S. REGAN, Laboratory for Laser Energies, University of Rochester, S. HSU, J. COBBLE, J. BAUMGAERTEL, P. BRADLEY, Los Alamos National Laboratory — We discuss the observation and analysis of implosion core spectrally-resolved image data from Ti-doped, deuterium-filled OMEGA direct-drive implosions. The targets were spherical plastic shells of varying thicknesses and gas pressures with a thin Ti-doped tracer layer at the fuel-shell interface. The spectral features from the tracer are primarily observed at the collapse of the implosion and recorded with three identical gated, multi-monochromatic x-ray imager (MMI) instruments fielded along quasi-orthogonal lines-of-sight. The gated data show simultaneous emission and absorption features associated with Ti K-shell line transitions. The spectrally-resolved images recorded with MMI were processed to obtain narrow-band images and spatially-resolved spectra characteristics of annular regions on the implosion core. Spectra yield electron temperature and density of the plasma in the core. An Abel inversion of the image’s intensity profiles and a complementary analysis method of the spatially-resolved Ti x-ray lines reveal the spatial distribution of the Ti in the core, and provide information on the symmetry and hydrodynamic stability of the implosion.


D1.00011 Multi-Parameter Characterization of Laser Ablation Plasmas¹. JEREMY IRAT-CABAL, TIMOTHY DARLING, PAUL NEILL, AARON COVINGTON, University of Nevada, Reno — The laser ablation of solid targets results in the formation of complex plasma plumes. The theoretical description of these plumes is challenging and requires multi-physics simulations bounded by accurate data on all aspects of ablation phenomena. To meet this challenge, a new experimental platform has been developed to characterize the spatial and temporal evolution of laser ablation plumes. This system records a variety of diagnostics that can be synchronized to a common master-clock. The common clock allows each ablation plume to be described in event-mode, where a careful examination of energy and momentum partitioning can be made for each ablation plume. The experimental system has been designed to survey a wide variety of target materials and geometries using laser intensities ranging from 10¹⁸ to 10¹⁹ W/cm². Physical parameters of the plumes are being measured with a powerful array of spectroscopic instruments, optical laser probes, charged particle analyzers, and nuclear instruments. A careful and accurate characterization of laser ablation plumes containing neutral and ionized atomic and molecular species provides measurements useful in high energy density physics, astrophysics, and technological fields.

¹Research at UNR was funded by the U.S. DOE under grant number DE-NA0002075.
D1.00014 Investigation of the 3D Structure of the Z-Pinch Using UV Laser Probing

AUSTIN ANDERSON, VLADIMIR IVANOV, University of Nevada Reno — The 3D structure of Z-pinches was investigated using four 266 nm beams. These beams were evenly spaced at 45 degrees with respect to each other, allowing a full view of pinch. The laser pulse duration is 150 ps, with a ~ 100 ps temporal accuracy between the 4 channels. Strong asymmetry was found in Z pinches produced by implosion of asymmetrical wire array loads. Studying the asymmetry of Z-pinches is important for understanding the 3D structure of Z-pinches and the effectiveness of using Abel inversion, which requires cylindrical symmetry. Results and a discussion are presented.

1Work was supported by the DOE grant DE-SC0008824 and DOE/NNSA UNR grant DE-FC52-06NA27616.

D1.00015 Neutron production using deuterated palladium wires

ERIK MCKEE, TIM DARLING, BEN HAMMEL, NTF, NTF COLLABORATION — The Zebra 1-MA/100ns rise time pulse power generator (HDZP-II) was initially designed to pinch single extruded wires of frozen deuterium in an effort to achieve fusion ignition [1], however solid thin-wire loads are now the main target. In general, the load for production of neutrons is a 4-wire, 20μm palladium wire in X-pin configuration treated with deuterium gas. The generation of neutrons on Zebra are not from realization of Lawson’s criterion [2], but rather are produced through beam-like collisions in MHD sausage-like instabilities with large and local electric fields. This project builds on the wire-array knowledge accumulated at NTF and we report on a reproducible, pulsed neutron source with yields exceeding 10^10.


D1.00016 Developing Software to Analyze Plasma Expansion

JEFFREY MEI, Univ of Nevada - Reno — Shadowgrams are used to analyze the expansion speed of plasma. However, it is difficult to define the border of the plasma in a shadowgram because the border is turbulent and contains laser speckle. Prior techniques to define the edge of a rod were done partly by eye. However, by adding the subjective human element in the procedure, the results are less likely to be reproducible. In addition, for low resolution images, even a pixel difference may significantly change the measured expansion rate. Therefore, the computer program LengthAnalysis was developed as a way to obtain robust measurements of shadowgram plasma widths. The edge of a shadowgram is defined by the largest change in contrast. LengthAnalysis utilizes the gray values obtained from the plot profile tool from the image processing program, ImageJ, to identify the areas of greatest change in contrast. Since the regions of greatest contrast change identify an edge, the difference between the two greatest regions of contrast yields the width. Though the idea is simple, laser speckle and the alignment of the target may alter the measurement of width. Laser speckle can move the regions of greatest contrast, while the slant of the target spreads out these regions in the plot profile.

1Supported by Sandia National Laboratories POI457882.

D1.00017 The ignition of the HB11 fusion reaction in a heterogeneous mutual impact configuration

FRIEWARDT WINTERBERG, University of Nevada - Reno — It was shown that the cross section-velocity product of a thermonuclear reaction averaged over a Maxwellian can be substantially increased in a mutual colliding impact configuration [1]. While the cross-section velocity product for the neutron-less hydrogen-boron11 reaction can thereby be increased by about 40%, the heterogeneous separation of boron from the hydrodynamics in a lattice has almost 50% reduction of the bremsstrah lungs- losses. Taken together, this leads to an approximately two-fold gain, sufficient to ignite the hydrogen-boron11 thermonuclear reaction [2].


D1.00018 Progress towards measuring gravity on the micrometer length scale with optically levitated silica microspheres

DAVID ATHERTON, GAMBIHIR RANJIT, JORDAN STUTZ, MARK CUNNINGHAM, ANDREW GERACI, University of Nevada, Reno — Discrepancies between the strength of gravity and other Standard Model forces suggest corrections to Newtonian gravity at the sub-millimeter length scale. In this poster, we present progress towards the realization of a system capable of measuring gravity at micrometer length scales. In ultra-high vacuum, optically-trapped and cooled microspheres show great promise as force sensors. They are completely decoupled mechanically from their environment and can have high Q factors. We are developing an apparatus to trap and cool spheres in a combined optical dipole-cavity trap. Ultimately, with a sphere trapped in an anti-node close to an end-mirror of the cavity, Non-Newtonian gravity-like forces will be tested by monitoring the displacement of the sphere as a mass is brought behind the cavity mirror.

1This work is supported by The University of Nevada in Reno and NSF grant PHY-1205994.

D1.00019 Modeling Sodium Nanowire’s With Monte Carlo Simulated Annealing

PEREYRA CARLOS, Cal State Univ - Sacramento, NANOWIRES TEAM — Building upon a Monte Carlo Simulated Annealing (MCSA) program, simulations were conducted on sodium nanowire’s to determine and analyze how atoms arrange themselves in equilibrium. Previous calculations based on the quantum motion of conduction electrons have shown that only wires with “magic” radii are stable [3]. “Magic” conductance values 1, 3, 6, 12, 17, were modeled and the radial and pair distance distributions of these structures were analyzed. Radial distribution results show that structures form discrete shells, or radial regions, where atoms tend to reside, while pair distance distributions give information about the periodic arrangements of the atoms. Finding the optimal set of parameters in the program that allowed for structures with minimal amount of disorder while keeping the computation time reasonable was the objective of this project. This has proved sometimes closer to an art form than a systematic search. This has worked well for the smaller wires, but larger wires still remain rather disordered regardless of these changes.

D1.00020 Ground-based and Satellite Retrieved Aerosol Properties Downwind of the 2013 California Rim Fire U.S.A.

DAMBAR AIR, WILLIAM ARNOTT, JAMES BARNARD, MADHU GYAWALI, Department of Physics, University of Nevada Reno — Wildfires are a common feature of western U.S. ecology. This presentation describes the radiative properties of the Rim Fire plume as it passed over Reno, NV in August 2013 and clear sky days for comparison. Aerosol physical and optical properties were obtained from ground based instruments, the Multifilter Rotating Shadowband Radiometer (MFRSR) and the CIMEL sun photometer operated as part of the NASA AERONET, MODIS satellite instruments, and in-situ measurements from photoacoustic (PA) instruments. Optical properties retrieved with the MFRSR show excellent agreement with those obtained with the CIMEL. However, satellite measurements indicate significant departure from the ground based measurements. The MFRSR retrieved single scattering albedo (SSA) of the Rim fire decreases with wavelength, from 0.91 at 415 nm to 0.86 at 870 nm. It was noteworthy that the SSA values from PA measurements and from the MFRSR retrievals were in agreement during the Rim fire; in contrast, they were very different for clean day. This presentation provides useful assessment of satellite retrieved AOD and determination of the aerosol optical and physical properties for the Rim Fire.
D1.00021 Low Cost Preparation of Nano-cellulose Ultrathin Transparent Paper. TIANLEI ZHOU, HYUNG WOO CHOI, GHASSAN JABBOUR, Univ of Nevada - Reno — We will present a low cost fabrication approach to ultrathin transparent paper based on blade coating of nano-cellulose. Depending on experimental and process conditions, an unprecedented thickness of 800 nm fully transparent paper (visible range) can be made. By tuning the process parameters, the optical transparency can be manipulated to suit a given application. For example, the substrate can be made with high haze which is suitable for certain lighting and display applications. Impact and other potential application of our approach will be highlighted as well.

D1.00022 Short Range Tests of Gravity. MICHAEL ROSS, CRYSTAL CARDENAS, MARIKA LEITNER, KOLBY BELL, C.D. HOYLE, Humboldt State University — Gravity was the first force to be described mathematically, yet it is the only fundamental force not well understood. The Standard Model of quantum mechanics describes interactions between the fundamental strong, weak and electromagnetic forces while Einstein’s theory of General Relativity (GR) describes the fundamental force of gravity. There is yet to be a theory that unifies inconsistencies between GR and quantum mechanics. Scenarios of String Theory predicting more than three spatial dimensions also predict physical effects of gravity at sub-millimeter levels that would alter the gravitational inverse-square law. The Weak Equivalence Principle (WEP), a central feature of GR, states that all objects are accelerated at the same rate in a gravitational field independent of their composition. A violation of the WEP at any length would be evidence that current models of gravity are incorrect. At the Humboldt State University Gravitational Research Laboratory, an experiment is being developed to observe gravitational interactions below the 50-micron distance scale. The experiment measures the twist of a parallel-plate torsion pendulum as an attractor mass is oscillated within 50 microns of the pendulum, providing time varying gravitational torque on the pendulum. The size and distance dependence of the torque amplitude provide means to determine deviations from accepted models of gravity on untested distance scales.

Saturday, October 25, 2014 2:00PM - 3:36PM — Session H1 Astrophysics and Gravitation JCSU 320 - Douglas Singleton, California State University, Fresno

2:00PM H1.00001 Ab initio Study of Cyclopropenone Formation in Interstellar Space. SEYEDSAEID AHMADVAND, RYAN ZAARI, SERGEY VARGANOV, Univ of Nevada - Reno, SERGEY A. VARGANOV TEAM — The recent discoveries of complex organic molecules such as cyclopropenone and glycoaldehyde in interstellar space have renewed the interest in astrochemical reaction mechanisms. We investigate three previously proposed reaction mechanisms for cyclopropenone formation in interstellar medium using ab initio quantum chemical methods. The nonadiabatic spin-forbidden reaction between atomic oxygen and cyclopropenylidene characterized by very small activation barrier and significant spin-orbit coupling between the lowest energies singlet and triplet states. We calculate the Landau-Zener probability of transition between the triplet and singlet states, and use nonadiabatic transition state theory to estimate the reaction rate constant of this spin-forbidden reaction. The reaction between acetylene and carbon monoxide, and between molecular oxygen and cyclopropenylidene, are two spin-allowed cyclopropenone formation pathways, also investigated in this work. Of the three studied reactions, the most probable mechanism of cyclopropenone formation in cold regions of interstellar space is between molecular oxygen and cyclopropenylidene since it is found to be a barrier free reaction.

2:12PM H1.00002 Improvement in applying observations to understanding glitches in pulsars1. SABRINA BERGER, Diablo Valley College, WILLIAM NEWTON2, Texas A and M University-Commerce — Some pulsars exhibit glitches - sudden decreases in period every few years - that may arise from the interactions between the neutron star crust and core. By comparing the predictions of theoretical models to empirical data of glitches, we hope to resolve the details of the glitch mechanism and constrain the underlying nuclear matter equation of state (EOS). The basic glitch paradigm supposes some part of the crust does not spin down with the rest of the star until a critical lag between the frequency of that part of the crust and the core is reached, at which point angular momentum is transferred from crust to core, spinning the star up. We focus on model predictions of how strongly the crust couples to the core: this determines how much of the core gets spun up and can be tested by data from the Vela pulsar. The crust and core couple via mutual friction, in which electrons scatter off of magnetized superfluid neutron vortices in the core. We generate many EOSs spanning the medium using ab initio quantum chemical methods. The nonadiabatic spin-forbidden reaction between atomic oxygen and cyclopropenylidene characterized by very small activation barrier and significant spin-orbit coupling between the lowest energies singlet and triplet states. We calculate the Landau-Zener probability of transition between the triplet and singlet states, and use nonadiabatic transition state theory to estimate the reaction rate constant of this spin-forbidden reaction. The reaction between acetylene and carbon monoxide, and between molecular oxygen and cyclopropenylidene, are two spin-allowed cyclopropenone formation pathways, also investigated in this work. Of the three studied reactions, the most probable mechanism of cyclopropenone formation in cold regions of interstellar space is between molecular oxygen and cyclopropenylidene since it is found to be a barrier free reaction.

2:24PM H1.00003 Mapping the cloudy skies of the galactic black hole Cyg X-1. NATALIE HELL, LLNL & Remeis-Sternwarte/ECAP/FAU, J. CLEMENTSON, MPI for Plasma Physics, P. BEIERSDORFER, D. LIEDAHL, LLNL, K. POTTSCHMIDT, CRE SST/UMBC & NASA/GSFC, F.S. PORTER, C.A. KILBOURNE, R.L. KELLEY, NASA/GSFC, V. GRINBERG, M.A. NOWAK, N.S. SCHULZ, MIT — The high mass X-ray binary Cyg X-1 consists of a black hole (BH) and its supermassive companion star. The system’s X-ray emission is powered through accretion of the companion’s strong stellar wind that is focused onto the BH. Observational evidence suggests that the wind is a two-component medium: clumps of cooler and denser material embedded in tenuous hot gas. The clumps passing through our line of sight cause strong flux reductions (dips) in the observed lightcurves. While the absorption lines of H- and H-like ions in the spectra exhibited from the dip-free phases are signatures of the hot gas, the cooler clumps cause additional absorption from lower ionized Si and S. Reliable atomic data are needed to derive Doppler shifts for these spectral lines, but the predicted uncertainty for the theoretical calculations is on the order of the expected shifts. We measured the K-shell transitions in L-shell Si and S ions at the LLNL electron beam ion trap. Combining the new reference data with the spectral signature of the clumps across various orbital phases allows us to map the clump distribution around the BH.

1 NSF provided funding to the physics department at Texas A and M University-Commerce to help conduct this research.
2 Faculty mentor

2:36PM H1.00004 Testing General Relativity with Continuous Gravitational Wave Polarizations. MAXIMILIANO ISI, ALAN WEINSTEIN, CARVER MEAD, California Institute of Technology, MATTHEW PITKIN, University of Glasgow, LIGO COLLABORATION — The direct detection of gravitational waves with the next generation detectors, like Advanced LIGO, provides the opportunity to measure deviations from the predictions of General Relativity. One such departure would be the existence of alternative polarizations. To measure these, we study a single detector measurement of a continuous gravitational wave from a triaxial pulsar source. We develop methods to detect signals of any polarization content and distinguish between them in a model independent way.
2:48PM H1.00005 Van der Waals Plasma Universe During Reissner-Nordstrom Expansion. VESSELIN GUEORGUIEV, Cal State Univ-Stanislaus, EMIL PRODANOV, ROSEN IVANOV, Dublin Institute of Technology, Ireland — A two-component gas, consisting of ultra-relativistic “normal” particles with specific charge $q/m$ and “unusual” particles with ultra-high charge $Q$ and ultra-high mass $M$ described by a Reissner–Nordström metric, is conceived as a van der Waals gas model of a plasma in early Universe. The model gives rise to an expansion process, Reissner-Nordstrom Expansion, that is analogous to a cosmic expansion during the radiation-dominated era. The Reissner-Nordstrom Expansion is due to the presence of a region with “gravitational repulsion” of the Reissner–Nordstrom metric with respect to the “normal” particles with $\text{sign}(Q)q/m \geq -1$. The expansion era naturally ends at recombination. We discuss the equation of state of the two-component van der Waals gas and the range of model parameters within which the proposed expansion process is consistent with the restrictions regarding quantum effects.

3:00PM H1.00006 Experimental Progress on Tests of Gravity at 20 microns. MICHAEL ROSS, CRYSTAL CARDENAS, Humboldt State University — Due to the incompatibility of the Standard Model and General Relativity, tests of gravity remain at the forefront of experimental physics research. At Humboldt State University, undergraduates and faculty are developing an experiment that will test gravitational interactions at the twenty-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 which will provide 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. This talk will provide a general overview of the experiment, as well as address the measurement and characterization of environmental systematic effects that must be understood in order to achieve the required sensitivity.

3:12PM H1.00007 Gravitational Origin of the Higgs Boson Mass. F. WINTERBERG, University of Nevada, Reno — With a positive-negative Planck mass plasma vacuum model I was able to predict a firewall at the event horizon of a black hole in a paper published in 2001 [1]. This same model can explain the Higgs boson as a particle made up from a very large positive mass ($+10^{13}$ GeV) quasiparticle gravitationally interacting with a likewise very large negative mass ($-10^{13}$ GeV) quasiparticle of this plasma, resulting in a spin 0 bound state of the positive and negative mass quasiparticles with an energy of the right order of 10$^2$ GeV to explain the Higgs boson mass as the positive gravitational interaction energy of a very large positive with a very large negative mass [2].

[1] F. Winterberg and Z. Naturforsch, Physical Sciences, 56a, 889 (2001);

3:24PM H1.00008 Energy and the Variational Principle in New Massive Gravity (NMG). COLIN CUNLIFF, American Institute of Physics (AIP) — New Massive Gravity (NMG)—a particular massive theory of gravity that is fourth order in derivatives of the metric—formulated around a three-dimensional anti-de Sitter ($AdS_3$) background faces two major problems. In general, higher-derivative Lagrangians generate unwanted boundary terms that spoil the variational principle. Additionally, global charges—including the mass and angular momentum of black holes—diverge in asymptotically $AdS_3$ spacetimes in the absence of a well-defined renormalization procedure. This talk shows how both problems can be resolved with the addition of boundary terms to the action of new massive gravity.

Saturday, October 25, 2014 2:00PM - 3:48PM — Session H2 Applied Physics and Life Science

JCSU 423 - Hendrik Ohldag, SLAC National Accelerator Laboratory

2:00PM H2.00001 Particles on the interface of oil and water: Topological Defects Produced by Anisotropic Particles. CHARLES MELTON, LINDA HIRST, University of California Merced — Topological defects have been the subject of many fascinating studies in soft condensed matter physics. The ability to control the onset of topological defects would prove to be invaluable to fields that benefit from defects such as electronics, the food industry, and pharmaceutical applications. In this study, the topological defects are studied in an oil/water emulsion system stabilized by polystyrene particles. The particles have varying aspect ratios, thus allowing for defects to be formed as a function of anisotropy. Fluorescence microscopy is used to image the particles on the interface between oil and water. Confocal microscopy is then used to image the particles in 3D space, allowing for a 3D mapping of the particles and reconstruction the oil/water interface. We observe spontaneous curvature of the interface when anisotropic particles are used and attribute this phenomenon to topological defects formed as a result of particle packing. Being able to visualize how particle packing and defect formation correlates to induced curvature of a deformable interface can aid in forming models that can explain the formation of topological defects in other systems, such as lipid bilayers and liquid crystal films.

2:12PM H2.00002 Determination of Surface-Substrate Adsorption Energy using the Exchange-Hole Dipole Moment. MATTHEW CHRISTIAN, UC Merced, ALBERTO OTERO DE LA ROZA, NINT, ERIN JOHNSON, UC Merced — Calculated surface-substrate binding energies are usually underestimated because conventional density functionals do not include dispersion, which is necessary to capture the van der Waals interactions that lead to weak physisorption. The exchange-hole dipole moment (XDM) model is a non-empirical density-functional approach to model dispersion. Adsorption energies for several aromatic molecules and nucleobases on noble metal surfaces were calculated using B86bPBE-XDM. In this talk, I compare the calculated adsorption energies with experiment and present implications for future applications to modeling surface interactions.

2:24PM H2.00003 Calculating thermal transport coefficients of reverse micelles using molecular dynamics simulations and normal mode analysis, HARI PANDEY, DAVID LEITNER, Univ of Nevada – Reno — Ultrafast vibrational studies of reverse micelles reveal that energy transfer from the water inside the reverse micelle to non-polar solvent can be more rapid than energy transfer from the surfactant directly to the solvent [1]. To address computationally the flow of heat in this system, we have calculated thermal transport coefficients for a reverse micelle formed by sodium di-2-ethylhexylsulfosuccinate (AOT) in isooctane over the temperature range 200 K–350K. Because of a “glassy” topology of the reverse micelle we adopted Allen-Feldman theory [2] to calculate thermal transport coefficients, which we have applied to calculate thermal transport coefficients for other soft matter in the past [3]. At room temperature, the thermal conductivity and thermal diffusivity of the reverse micelle was found to be 0.13 W/mK and 5.86 A²/s respectively, the former agreeing well with experimental values in polyalphaolefins solvent.


2:36PM H2.00004 Interplay between group function of kinesin based transport and the planar lipid bilayer’s recovery time after photobleaching, JOSEPH LOPES, JING XU, LINDA HIRST, UC Merced — Motor proteins, discovered in recent decades, are important building blocks to life. These molecular machines transport cargo and although indispensable to cell function, are not well understood at present. Single kinesin transport properties have been documented, but their group function remains unknown. In this project, the properties of kinesin-based transport by multiple motors are investigated in-vitro to establish a link between travel distance and lipid diffusion in the vesicle membrane. In the experiments, silica beads coated in a supported lipid membrane and giant lipid vesicles are transported along a microtubule by embedded kinesin motors. To measure the diffusion properties of the membrane a planar lipid bilayer is prepared on a silica slide supported by bovine serum albumin protein. To establish a diffusion constant at room temperature for the lipid membrane we use the FRAP technique (fluorescence recovery after photobleaching). Using this method we can investigate if there is any interplay between group travel function and membrane fluidity.

3:00PM H2.00005 Hydrophobic Gating in Single Conically Shaped Nanopores1, WILLIAM MANN, DIEGO GUTIERREZ, California State University, Long Beach, LAURA INNES, ZUZANNA SIWY, University of California, Irvine — Voltage-gated biological channels are understood to use hydrophobic interactions in their gating mechanism. To better understand how these interactions control ionic transport, mimics were created using single conical nanopores in 12 μm thick polyethylene terephthalate (PET) films. Pores were prepared by the track-etching technique: single ion irradiated foils were subjected to asymmetric wet-chemical etching. The pores used had a narrow opening between 3 and 11 nm, and a big opening ~500 nm. This study investigates the ion transport properties of nanopores, modified with decylamine to render the PET surface hydrophobic. Modification was verified by current-voltage (I-V) curves of the pore before after attachment of decylamines. Hydrophobic pores often exhibit hydrophobic gating i.e. there is a voltage range for which there is no measurable ion current. In our experiments voltages of few hundred mV had to be applied to see finite ionic transport. The closed state of the pore is believed to correspond to a pore being filled with water vapor; a conducting indicates condensed water. Hydrophobic gating is also characterized by hysteresis: the voltage magnitude needed to open the pore for ionic current is larger than that for which the pore closes.

1This project is supported in part by the National Science Foundation and the Department of Energy.

3:12PM H2.00007 Liquid Crystalline Orientational Control via the Electric Field of Localized Surface Plasmons1, MAKIKO QUINT, University of California Merced — Collective oscillation of the electrons in gold nanoparticles (localized surface plasmon resonance (LSPR)) can produce a net electric field when excited at a resonant frequency. We have investigated the effects of LSPR-induced electric fields around self-assembled 30nm gold nanoparticles (AuNPs) on a thin film of nematic liquid crystal. Such a device configuration has the potential to act as an optically excited liquid crystal switch. We reversibly switch the spatial orientation of nematic liquid crystal molecules from homeotropic to planar in the thin films, demonstrating the action of this new device mode. We present electric field simulations for the system and control measurements for off-resonance excitation in which the switching behavior is not observed. Using polarized microscopy and optical transmission measurements, we observe switching over a temperature range starting several degrees below and up to the isotropic transition.

1This work was supported by the nanoBIO node of the National Science Foundation.

3:24PM H2.00008 Evolution of electrode behaviour under pressure, STEPHEN DALE, University of California, Merced, ALBERTO OTERO-DE-LA-ROZA, National Institute for Nanotechnology, Edmonton, ERIN R. JOHNSON, University of California, Merced — Electrodes are a unique class of ionic materials in which the anions are stoichiometrically replaced by localised electrons. The localised electron gives electrodes a number of unique properties including high hyperpolarisabilities, high magnetic susceptibilities, highly variable conductivities, extremely low work functions, low-temperature thermionic emissions and very strong reducing character. However, the majority of the known electrodes are unstable at room temperature and consequently experimental studies of these materials are difficult. Theoretical modelling of these systems can greatly benefit the exploration of these materials. We use density-functional theory (DFT) to show the presence of a localised electron and high lying “electrode” valence state in all of the known electrodes. Pressure calculations are then conducted to explore the stability range of electrodes under pressure. This helps identify ideal crystal void sizes and is the beginning of elucidating a directed design criteria for electrodes.
3:36PM H2.00009 Optical RF to mechanical coupling of a thin membrane as one end of a cylindrical cavity, ALESSANDRO CASTELLI, LUIS MARTINEZ, University of California, Merced, JERRY SPEER, None, JAY SHARPING, RAYMOND CHIAO, University of California, Merced — We demonstrate coupling of an 11.1 GHz radio frequency (RF) TE011 cylindrical cavity mode to the mechanical motion of a silicon nitride (Si3N4) membrane. The membrane is driven into motion by modulating the amplitude of the RF signal at the membrane’s resonant frequency of approximately 6.7 KHz. The membrane’s displacement is measured by means of a Michelson interferometer. This experiment shows that the TE011 mode gives rise to radiation pressure on the ends of a cylindrical cavity and demonstrates the feasibility of future work using high Q superconducting RF cavities to realize a dynamical Casimir effect (DCE) due to the membrane’s motion at GHz frequencies.

Saturday, October 25, 2014 2:00PM - 3:48PM –
Session H3 High Energy/Accelerator Physics

2:00PM H3.00001 A Synchrotron Radiation Research Facility for Africa, HERMAN WINICK, SLAC National Accelerator Laboratory — Africa is the only habitable continent without a synchrotron light source. Dozens of African scientists use facilities abroad. Although South Africa has become a member of ESRF, the number of users is limited by distance and travel cost. A light source in Africa would give thousands of African scientists access to this tool. Momentum is now building for an African light source, as a collaboration involving several sub-Saharan African countries. An interim Steering Committee has been formed. SESAME, now nearing completion in Jordan as a collaboration of 9 countries in the Middle East (www.sesame.org.jo) may be the example followed. UNESCO became the umbrella organization for SESAME at its Executive Board 164th session, May 2002, as it did in the case of CERN in the 1950s. UNESCO’s Executive Board described SESAME as “a quintessential UNESCO project combining capacity building with vital peace-building through science” and “a model project for other regions.” It is likely that UNESCO, if asked, would play a similar role as a facilitator for an African light source.

2:12PM H3.00002 mono-Z’: The discovery potential in a search for dark matter in events with a Z’ boson and missing transverse energy, KEVIN BAUER, MARCELO AUTRAN, Univ of California - Irvine, TONGYAN LIN, University of Chicago, DANIEL WHITESON, Univ of California - Irvine — We analyze the LHC’s potential for dark matter discovery in ATLAS events with missing transverse energy and a Z’ decaying to a pair of jets or leptons. Many dark matter searches are ongoing at the LHC, analyzing events with missing transverse energy. However, a final state of Z’ and missing energy has not yet been studied and contains significant discovery potential. Examples of effective field theory models for Z’ production with dark matter are searches are ongoing at the LHC, analyzing events with missing transverse energy. However, a final state of Z’ and missing energy has not yet been studied and contains significant discovery potential. Examples of effective field theory models for Z’ production with dark matter are introduced. Using simulations of the 8 TeV LHC run, we explore reconstruction and selection strategies and discuss our sensitivity by comparing our expected limits to existing theory parameter limits.

2:24PM H3.00003 A Cryogenic Piezoelectric Rotary Drive System for the Axion Dark Matter Experiment, KELLY BACKES, BELLA URDINARAN, UC Berkeley, ADMX / ADMX-HF COLLABORATION — The nature of Dark Matter is a central mystery in physics and one candidate particle is the axion. Axions can be detected by their conversion to microwave photons in a cryogenically cooled resonant cavity immersed in a magnetic field. The microwave cavity’s resonant frequency must be tuned to match the axion’s mass, which is currently an unknown parameter. This frequency can be changed by rotating tuning rods inside of the cavity. Currently a system of stepper motors and gear boxes is used to tune these rods, but the gear boxes add too much heat. The experiment needs to run as cold as possible to minimize the background noise from blackbody radiation. A rotary drive system based on piezoelectric’s should generate much less heat. Commercial piezo systems are expensive and have low torque so we are using more inexpensive design that should give higher torque. The behavior of this piezoelectric system will be discussed.

1Supported by DOE Grants DE-FG02-97ER41029, DE-FG02-96ER40956, DE- AC52-07NA27344, DE-AC03-76SF00098, NSF grants PHY-1067242 and PHY-1306729, and the Livermore LDRD program.

2:36PM H3.00004 Updates from the ADMX-HF Experiment, TIMOTHY SHOKAIR, University of California, Berkeley — The Axion Dark Matter eXperiment - High Frequency (ADMX-HF) is a collaboration of JILA/Colorado, LLNL, UC Berkeley, and Yale to search for dark matter axions in the 4-10 GHz (20-100 µeV) range. The method is to convert axions into photons via the Primakoff effect in a cylindrical microwave cavity immersed in an ultra-cold 9T magnet. In addition to probing a new mass range of axions, ADMX-HF will serve as a test-bed for new concepts in microwave cavity axion detection. Concepts include hybrid superconducting cavities and operation in squeezed-state modes to reduce amplifier noise. The experiment is currently in the commissioning phase, and is expected to be in full data-taking mode by the end of 2014.

2:48PM H3.00005 The time-dependent non-Abelian Aharonov-Bohm effect, MAX BRIGHT, DOUGLAS SINGLETON, California State University, Fresno — In this talk I discuss the time-dependent Aharonov-Bohm effect for non-Abelian gauge fields. We use the well known Coleman plane wave solutions to the time-dependent Yang-Mills field equations to investigate the non-Abelian Aharonov-Bohm phase shift. For this solution, we find a cancellation between the phase shift coming from the non-Abelian “magnetic” field and the phase shift coming from the non-Abelian “electric” field, which inevitably arises in time-dependent cases. We compare these results to the results for the Abelian time-dependent Aharonov-Bohm effect.
Moreover, we describe our data acquisition setup using a Raspberry Pi computer and custom made programs to analyze and receive the sensor signals using the Xbee's onboard 10bit ADC. We have successfully implemented a mesh network consisting of 4 Xbee modules placed very sensitive to changes in temperature. At this conference, we describe our experiments in using the popular Xbee wireless transceivers as capable of measuring very dim light and single photons. It is biased slightly above the breakdown voltage, which results in high gain that is also very sensitive to changes in temperature. At this conference, we describe our experiments in using the popular Xbee wireless transceivers as possible communication devices to remotely monitor the changes in temperature for the SiPM from Hamamatsu. The Xbee modules are paced in a mesh network and communicate from a distance to monitor the resistance from platinum temperature sensors, to be incorporated with the possible communication devices to remotely monitor the changes in temperature for the SiPM from Hamamatsu, as readout detectors for plastic scintillators. Our investigation, includes implementation of a novel design that automatically adjusts for the bias voltage to the MPPC detectors to compensate for changes in the ambient temperature. We present results in using short pulses as test input waveforms for unity gain amplifiers (TI LMH6559) constructed to maintain the detector signal integrity over long length of cable. Furthermore, we describe our investigations for the MPPC detector characteristics at different bias voltages and temperatures. Our experimental set up consists of a 5 Giga sample/second waveform digitizer, the DRS4, triggered to capture the MPPC detector waveforms, in coincidence with a cosmic ray telescope. Analysis of the digitized waveforms, accomplished using the CERN package PAW, would be presented.

1Department of Education

3:12PM H3.00007 Investigation of the Effect of Temperature on Silicon Photomultiplier for Cosmic Ray Detectors1, DANIEL RUIZ CASTRUITA, FATIMA RAMIREZ, Hartnell Community College, STEFAN RITT, Paul Scherrer Institute — The silicon photomultiplier (SiPM) is an extremely sensitive light detector capable of measuring very dim light and single photons. Its high gain comes from operating at slightly above the breakdown voltage, which is also accompanied by high dark count rate. At this conference, we describe our investigation of using SiPM, the multipixel photon counters (MPPC) from Hamamatsu, as possible readout detectors in a cosmic ray scintillating detector array. Our investigation, includes implementation of a novel design that automatically adjusts for the bias voltage to the MPPC detectors to compensate for changes in the ambient temperature. We present results in using short pulses as test input waveforms for unity gain amplifiers (TI LMH6559) constructed to maintain the detector signal integrity over long length of cable. Furthermore, we describe our investigations for the MPPC detector characteristics at different bias voltages and temperatures. Our experimental set up consists of a 5 Giga sample/second waveform digitizer, the DRS4, triggered to capture the MPPC detector waveforms, in coincidence with a cosmic ray telescope. Analysis of the digitized waveforms, accomplished using the CERN package PAW, would be presented.

1Hartnell Research Scholars Institute

3:24PM H3.00008 Implementing Xbee Wireless Network to Monitor Cosmic Ray Detectors, ROMMEL NIDUAZA, Hartnell Community College — The silicon photomultiplier (SiPM) is a highly sensitive light detector capable of measuring very dim light and single photons. It is biased slightly above the breakdown voltage, which results in high gain that is also very sensitive to changes in temperature. At this conference, we describe our experiments in using the popular Xbee wireless transceivers as possible communication devices to remotely monitor the changes in temperature for the SiPM from Hamamatsu. The Xbee modules are paced in a mesh network and communicate from a distance to monitor the resistance from platinum temperature sensors, to be incorporated with the SiPM detectors. Our investigations include extensive evaluation of the Xbee units for readout of the platinum sensor voltages for digitizing the sensor signals using the Xbee’s onboard 10bit ADC. We have successfully implemented a mesh network consisting of 4 Xbee modules placed at indoor settings and have tested the network communications for maximum range between 2 Xbee modules at outdoor settings as well. Moreover, we describe our data acquisition setup using a Raspberry Pi computer and custom made programs to analyze and receive the sensor data communicated between Xbee modules.

3:36PM H3.00009 Antimatter May be a Form of Dark Matter, WALTON PERKINS, Retired — Two observed properties of dark matter are that it does not emit light (that we can detect) and it does not reflect ordinary light. A comparison of the elementary and composite photon theories shows that they are very similar with each theory having advantages in some areas. The major difference is that in the composite theory the antiphoton is different than the photon. While the composite photon is formed of a left-handed electron neutrino and a right-handed electron antineutrino, the antiphoton is formed of a right-handed electron neutrino and a left-handed electron antineutrino. The neutrino and antineutrino of the antiphoton have the wrong helicity to interact with ordinary matter because the weak interaction V = A. The only interaction of such neutrinos with matter would be through gravity. In a symmetric manner the neutrino and antineutrino of the photon have the wrong helicity to interact with antimatter where the weak interaction is V + A. Thus, we could not detect light from antimatter galaxies, and ordinary photons would pass through antimatter galaxies without interaction. These predictions of the composite photon theory will be tested in the upcoming ALPHA and ASACUSA antihydrogen experiments. The matter-antimatter asymmetry puzzle could be solved if the universe contains an equal amount of matter and antimatter. Antimatter galaxies may not have been observed because their antiphotons are not detectable. However, the presence of antimatter equal to matter in the universe cannot explain all the observed effects of dark matter.

Saturday, October 25, 2014 2:00PM - 3:36PM – Session H4 Nuclear Physics  JCSU 323 - Ken Ganezer, California State University, Dominguez Hills

2:00PM H4.00001 An Estimate for the Systematic Uncertainty Associated with the Polarization of the Upsilon Meson at CMS, BRANDON MCKINZIE, Univ of California - Davis — An estimate for the systematic uncertainty associated with the polarization of the Upsilon meson is presented for the LHC heavy-ion collision energy of √NN = 2.76 TeV. Kinematic cuts are applied to simulated collision data in order to model the acceptance of the CMS detector. The systematic uncertainty is then plotted as a function of θ y for both high- and low-acceptance polarization cases. We find that Upsilon acceptance varies as a function of θ y, with, when no kinematic cuts are applied, as high as a twelve-percent difference between levels of polarization (at low θ y) and, when kinematic cuts are applied, as high as a four-percent difference (at mid θ y).

2:12PM H4.00002 Z+Jet Simulations In p+p and Pb+Pb Collisions at the LHC, JOSHUA GEARHART, Univ of California - Davis — Z+jet measurements provide a relatively clean probe for energy loss in the QGP, but this process has an extremely low cross section. The statistics of this measurement will benefit greatly from the increased energy of the LHC following the recent shutdown allowing us to make a reliable measurement of this process. We can get an idea of what sort of a signal to expect by using the jet quenching event generator PYQUEN to create the Z+jet event along with the heavy ion event generator HYDJET to create a full heavy ion collision background. We can then use the jet finding software FastJet to compare the kinematics of the jet to that of its partner Z boson since their transverse momenta should be correlated to leading order. These simulations can then be compared to the upcoming Pb+Pb data as well as the recently acquired p+Pb data.
2:24PM H4.00003 Performance of a Newly Installed Muon Telescope Detector in the STAR Experiment at RHIC, KATHRYN MEEHAN, UC Davis — The Muon Telescope Detector (MTD) has recently been installed into the STAR experiment at the Relativistic Heavy Ion Collider (RHIC). Heavy ion collisions allow us to create quark gluon plasma (QGP) in the laboratory and to study strong interactions. The new detector enables STAR to detect muons from quarkonia decays. This opens a new, cleaner channel to study particles that give an insight into thermodynamic properties of the QGP. The MTD will allow us to measure quarkonia production at RHIC with unprecedented precision. Performance plots of the MTD in the 2014 run will be shown.

2:36PM H4.00004 Final Construction Phase of the CLAS12 High-Threshold Čerenkov Counter, SHANE MILLER-SMITH, JOHN PRICE, Cal State Univ-Dominguez Hill — The CLAS detector at the Thomas Jefferson National Accelerator Facility in Newport News, VA (JLab) is currently undergoing an upgrade. A significant part of the particle-identification system for this detector is the Čerenkov counter, used to distinguish electrons from other particles in the detector. At the energies that will be available upon completion of the upgrade, the existing Čerenkov counter will be insufficient. To alleviate this situation, a new, high-threshold Čerenkov counter (HTCC) is being built. This new detector will utilize a mirror assembly to direct the Čerenkov photons into a region of the detector with a low magnetic field. The construction of the mirror assembly required a clean-room environment that approximated the actual laboratory conditions as closely as possible to prevent mirror warping after installation. The clean-room environment, which was built specifically for this purpose, had to be continuously monitored for temperature, humidity, and particle count. The mirror assembly was prepared by attaching previously fabricated and tested mirror segments to a center ring in such a way that the entire structure was self-supporting and rigid, while minimizing the amount of material used in its construction. Because the transport of the finished detector into the laboratory is expected to apply stresses to the mirrors, a half-sector assembly was constructed to test the effects of this transport. Additionally, a significant effort was spent in the preparation and installation of the shields for the photomultiplier tubes used to detect the Čerenkov photons. This talk will discuss the final stages of the assembly and construction of the HTCC, and will show the present status of the detector.

2:48PM H4.00005 Application of the Extended Pairing Model to Heavy Isotopes, VESSELIN GUEORGUIEV, Cal State Univ-Stanislaus, FENG PAN, Liaoning Normal University, Dalian 116029, China, JERRY DRAAYER, Louisiana State University, Baton Rouge, LA — Relative binding energies (RBEs) within three isotopic chains (\(^{100-130}\)Sn, \(^{152-181}\)Yb, and \(^{181-202}\)Pb) have been studied using the exactly solvable extended pairing model (EPM) [Phys. Rev. Lett. 92 (2004) 112503]. The only unique pairing strength \(G\), which reproduces the experimental RBEs, has been determined. Within EPM, log(\(G\)) is a smooth function of the model space dimension \(\text{dim}(A)\), as expected for an effective coupling strength. In particular, for the Pb and Sn isotopes \(G\) can be described by a two parameter expression that is inversely proportional to the dimensionality of the model space, \(G = \alpha \text{dim}(A)^{-\beta}\) with \(\beta \approx 1\). PACS Classification: 21.10.Dr Binding energies, 71.10.Li Pairing interactions in model systems, and 21.60.Cs Shell model.

3:00PM H4.00006 Matrix continued fractions for the Feshbach-Villars equations, NATALIE BROWN, ZOLTAN PAPP, ROBERT WOODHOUSE, California State University of Long Beach — Relativistic spin-zero particles are mostly described by the Klein-Gordon equation. However, there exists an equivalent, little known, formulation, the Feshbach-Villars formalism. In the Feshbach-Villars formalism, the Klein-Gordon wave function is broken into two components such that the equations appear in a Hamiltonian form with first order time and second order spatial derivatives. The aim of this work is to develop a solution method for the Coulomb plus short-range potential problems. We write the Feshbach-Villars equations in a Lippmann-Schwinger form and we calculate the corresponding matrix continued fraction. We illustrate the efficiency of the method by calculating the eigenstates of an attractive Coulomb plus Yukawa potential.

3:12PM H4.00007 Laser Forced Nuclear Fission, RICHARD KRISKE, University of Minnesota — Although it is well known that Lasers of the right wavelength can produce Nuclear Fusion and they can also be used in the Nuclear Fission enrichment process, it is not as well known that it may be possible to Force non fissile quantities of Uranium and Plutonium as well as Nuclear waste products to go into a state of Nuclear Fission. A Laser beam (perhaps a FEL beam) could potentially produce a short enough wavelength in the Hard X-ray spectrum or perhaps into the Gamma Ray spectrum and knock Neutrons out of the Nucleus and through constant application of the Laser beam force a small quantity into Nuclear Fission. The uses of this application would not be just to destroy Nuclear warheads in the Hard X-ray spectrum or perhaps into the Gamma Ray spectrum and knock Neutrons out of the Nucleus and through constant application of the Laser beam force a small quantity into Nuclear Fission. This opens a new, cleaner channel to study particles that give an insight into thermodynamic properties of the QGP. The MTD will allow us to measure quarkonia production at RHIC with unprecedented precision. Performance plots of the MTD in the 2014 run will be shown.

3:24PM H4.00008 Nobel Prize in Physics 1921 Was Awarded to Albert Einstein for a Wrong Law!, AHMAD REZA ESTAKHR, Researcher — The nobel prize in physics 1921 was awarded to Albert Einstein for wrong law of Photoelectric effect. According to Einstein’s theoretical explanation, emission of electron is not possible for frequency less than threshold one, But I noted that Einstein’s explanation is inconsistent with well established effect of Quantum tunnelling. (In fact classical limit of my law of photoelectric effect is Einstein’s law of the photoelectric effect.)