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Friday, November 13, 2009 1:00PM - 3:48PM –
Session F1 Astrophysics Spanagel 117

1:00PM F1.00001 An Alternative Explaination to CMBR based on Curvature RICHARD KRISKE, University of Minnesota — The author would like to propose an alternative explaination to the CMBR based on curvature instead of temperature. When one looks at the horizon of a curved surface such as the earth, that horizon is non-magnifiable due to the fact that objects not only shrink but tilt away from the observer as well. This clue applied to horizons in 3 dim. of curved space and one perp. time dimension (which would tilt backward, away from the observer and result in a nonmagnifiable 2 dim. surface, in all directions). The temperature of the resulting area (similar to the look of the resulting line of the earth's horizon) would tell the observer the mass and the curvature of the surface. The reason that the time vectors on the other side of the Universe do not contribute is that they are backward in time and the parallel displaced vectors would result in a particle that we would not interpret as a photon (it would appear to be a photon moving backward in time - and thus adding a correction to QED/QCD). The implications of this may shake the foundations of Physics in that it gives a direct connection between the shape of the Universe and spin. Pilots use the Horizon to determine up and down, in a 4 space this would give absolute meaning to spin and tell the correct number of dim. of the manifold. The author submits that there may be enough evidence to conclude that this is the correct interpretation of the CMBR and the Big-Bang in its simple form is not.

1:12PM F1.00002 Fermi-LAT Sensitivity to Dark Matter Annihilation in Via Lactea II Substructure , BRANDON ANDERSON, UC Santa Cruz, MICHAEL KUHLEN, Institute for Advanced Study, Princeton, ROBERT JOHNSON, Santa Cruz Institute for Particle Physics, PIERO MADAU, JUERG DIEMAND, UCO/Lick Observatory, FERMI-LAT COLLABORATION — We present a study of the ability of the Fermi Gamma-ray Space Telescope to detect dark-matter annihilation signals from the Galactic subhalos predicted by the Via Lactea II N-body simulation. We implement an improved formalism for estimating the boost factor needed to account for the effect of dark-matter clumping on scales below the resolution of the simulation, and we incorporate a detailed Monte Carlo simulation of the response of the Fermi-LAT telescope, including a simulation of its all-sky observing mode integrated over a ten year mission. The results are less optimistic than previous estimates that did not fully account for the variations of the LAT effective area and point-spread function. Nevertheless, for WIMP masses up to about 150 GeV/c^2 in standard supersymmetric models a few subhalos could be detectable with > 5 standard deviations significance and would likely deviate significantly from the appearance of a point source.

1:24PM F1.00003 The Search for Ultra High-Energy Neutrinos With The ANITA Experiment , ABIGAIL VIEREGG, UCLA, ANITA COLLABORATION — The ANITA (ANtarctic Impulsive Transient Antenna) experiment is an innovative balloon-borne radio telescope, designed to detect coherent Cherenkov emission from cosmogenic ultra high-energy neutrinos with energy greater than 10^{18} eV. The second flight of the ANITA experiment launched on December 21st 2008, and collected data for 30 days. This large data set allows for the most sensitive investigation into the exciting GZK (Greisin-Zatsepin-Kuzmin) neutrino flux regime to date. I will present the status of the first pass analysis of the ANITA-II data set. I will discuss calibration techniques, analysis methods, and background rejection.

1:36PM F1.00004 Observation of UHE Cosmic Rays from a Balloon-borne Neutrino Telescope , STEPHEN HOOVER, UCLA, ANITA COLLABORATION — The ANtarctic Impulsive Transient Antenna (ANITA) is a balloon-borne array of radio antennas designed to detect coherent radio Cherenkov radiation from ultra-high energy (UHE) neutrino-induced particle showers in the Antarctic ice sheet. The first flight of ANITA has produced limits on the UHE neutrino flux, and analysis of data from the second flight is underway. I will describe the neutrino search and concurrent observations of geosynchrotron radio emissions from UHE cosmic ray extensive air showers.

1:48PM F1.00005 Can Dark Matter explain the WMAP Haze? , TIM LINDEN, UCSC — There is currently a significant effort to observe indirect evidence of dark matter annihilation in our galaxy. One interesting finding was an unexpected synchrotron haze (the "WMAP haze") with a similar intensity and morphology to those predicted by dark matter models. This might also be connected to another recent puzzle in cosmic ray physics: the excess of high energy positrons reported by the Pamela satellite. We evaluate a wide variety of well motivated dark matter particle physics setups as well as cosmic ray propagation models, and compare the simulated dark matter driven synchrotron signal against the observed WMAP haze. Further analyzing several reasonable dark matter fits to the WMAP haze, we determine the expected inverse-Compton scattering and positron/electron signals which should be detectable by cutting edge Fermi and Pamela observations.

2:00PM F1.00006 Waves in an accretion disk: nodal superhumps versus permanent superhumps in V378 Pegasi , KENIA VELASCO, F.A. RINGWALD, JONATHAN ROVETO, California State University, Fresno — First science results from a new observatory, Fresno State's station at Sierra Remote Observatories, are presented. The nova-like cataclysmic variable V378 Pegasi (PG 2337+300) is discovered to show variable, often sawtooth-wave variations in its light curve, which have a period of 3.22 hours. These variations are present in light curves taken in 2001, 2008, and 2009, and have amplitudes between 0.2 and 0.4 magnitudes, as detected through a clear filter. We identify these as waves in this close binary star system's accretion disk, which are related to the superhump phenomenon shown by SU UMa stars. We also present the results of a radial velocity study to measure the orbital period, and discuss physical models for the variation in V378 Peg: either permanent superhumps, in which the disk is made elliptical and precessed by tidal forces from the stars' pronounced mass ratio, or nodal superhumps, from a tilted disk. We also discuss the evolutionary status of V378 Peg: at just above the period gap, this system may provide a critical test of cataclysmic variable evolution theory.

2:12PM F1.00007 Quantum Universe Theory , BRUCE CUNNINGHAM — The Initial Condition (that which existed prior to the universe) is compared as an infinite thermodynamic system (reservoir and system) to a two-component blackbody system, where one component, composed of unbound bosons, contained a symmetry breaking potential. Symmetry breaking resulted in the moment of inflation in a subsystem (small part) of one component, which in turn ignited an unloading wave. The ensuing Big Bang Unloading Wave created a continuously expanding cavity in that component. The cavity is the universe. Within the expanding unloading wave, the first energy cascade has continuously produced intense plasma effects, superelectric fields, and supermagnetic effects. The intense plasma produces violent pinch effects propelling superelectric-magnetic particles to the speed of light c impacting them within the other component (bound boson Fermi-Dirac particles) as original energy particles representing the apex of the spectral ladder and the beginning of the second energy cascade. Here quench factors freeze persistent superconducting current vibrations into place prior to application of the algorithmic ladder of the quantum field theory time line. Energies evolve to include the formation of std model physics (QM,QED,QCD) general theory of relativity (GRT), special theory (SRT), linear momentum, and angular momentum, etc.

2:24PM F1.00008 Video Crosstalk in Kepler CCDs , JASON VON WILPERT, University of California Santa Cruz — Kepler is the first mission capable of detecting Earth-size planets in the habitable zone of solar-like stars, and is at the forefront of the exciting field of extrasolar planets. Kepler looks for planetary transits in F-M main-sequence stars, ranging from 7^{th} to 14^{th} magnitude. I investigate video crosstalk, which is the noise due to coupled readout of CCDs. Video crosstalk is modeled as a linear coefficient multiplied by the signal from the source CCD, and can be as large as 0.066% of the signal. The transit of an Earth-size planet in Kepler's field of view is a 0.01% drop in flux, so video crosstalk can significantly skew planet mass estimations. It produces both positive and negative images, and is not symmetric between two CCDs. While the exact cause for this phenomenon remains to be clarified, the undesirable effects of video crosstalk have been mitigated, and specific stars in Kepler's field of view with high amounts of crosstalk have been flagged for more thorough analysis of flux measurements.

2:36PM F1.00009 An Overview of Hubble's Newest Addition: WFC3 , LUCY MCLAURIN, University of California, Santa Cruz, DEEP TEAM — The newest camera on the Hubble Space Telescope (HST), Wide Field Camera 3 (WFC3), opens a new window into the Universe. WFC3's two channels (UVIS and IR) provide HST with improved imaging capabilities in the ultraviolet and near-infrared wavelengths and allow for clearer and more detailed images of the universe compared to previous generations of instruments. A review of instrument specifications, features, and operation of the IR and UVIS channels work is provided. Advancements of WFC3 are described, including enhancements of CCD and IR detector technology. WFC3 has many benefits and few drawbacks compared to past and future instruments. With improved spatial resolution, a large field of view, and reduced noise, WFC3 is capable of reaching many scientific goals for the first time. New science goals include studies of galactic evolution and improved resolution of high redshift galaxies. I will illustrate the capabilities of WFC3 with specific examples relating to the study of galaxy formation.

2:48PM F1.00010 Theoretical Derivation of Equations Governing the Coupled Distributions of Dark and Baryonic Matters , JACQUES LEIBOVITZ — A dark matter (DM) particle is yet to be detected. Milgrom's modified Newton dynamics (MOND) successfully models much of the observed DM phenomena. Unfortunately, the modification conflicts with general relativity. Exploring here an alternative model of DM leads to the sequential derivation of an equation of state (EoS) for such DM in a gravitation field, of an equation governing the coupled distributions of DM and baryonic matter around galaxies, of galactic flat rotation curves, of the Pioneer anomaly, of a Tully-Fisher relation, of a possible mechanism of black hole formation at the center of a large galaxy, and of Milgrom's MOND relation. The conflict between the PA and the Viking ranging data is resolved in an appendix. Results are discussed.

3:00PM F1.00011 A Different Reason Why Black Holes are Black , NOHA S. FARGHAL — Although it is true that black holes appear to be black on the outside due to the fact that the escape velocity from the event horizon is even higher than that of light, black holes may be black on the inside as well. A recent paper by Zach Adams (2009) presents a new model which provides evidence of gravitons actually being a result of a fusion of 2 photons, which manifests in 4-D space. In fact, the duality between gravitons and photons has been suggested in earlier works as well. Falling Photon Experiment shows that as photons approach a massive body, their energies increase, and their wavelengths decrease. Photon-graviton conversions occur when the wavelengths of photons decrease to Planck's length. As a result, the photons approaching the event horizon of a black hole may gain energy enough for photon pairs to fuse and become gravitons. Therefore, as we will discuss in this work, there exists a probability that photons cannot survive within the event horizon of a black hole. It is true that nothing can escape a black hole, which is the reason why it looks black on the outside, but also the possibility that photons may not be able to survive on a black hole means that black holes may be black on the inside as well.

3:12PM F1.00012 Quantum trajectories for entanglement phenomena , EDWARD FLOYD[1], 10 Jamaica Village Rd, Coronado, California — Quantum trajectories are used to investigate entangled systems. Herein, we present a procedure or recipe for applying the quantum trajectory representation to entanglement. We may synthesize the wave function for an entangled system from the wave functions of the individual anyons comprising the entangled system. The reduced action (generator of the motion) for the entire entangled system may be extracted from entangled system's wave function rather than from solving the quantum Hamilton-Jacobi equation if, for sufficiency, all the wave functions for the individual anyons are complex. Applying Jacobi's theorem to reduced action renders the quantum trajectory for the entangled system. We exhibit quantum trajectories for entangled systems that give insight into EPR, wave packet spreading, and the quantum Young's experiment. Dissection of the trajectory equation for the entangled system reveals the emergence of an "entangalon" that maintains entanglement within the system.

[1]Unaffiliated & retired. Coronado is home address.

3:24PM F1.00013 Tutorial Device Illustrating A Spin One-Half Object , VLADISLAV BEVC, Synergy Institute, P.O. Box 561, San Ramon, California 94583 — Hawkins (The Universe in a Nutshell) illustrates a spin 1 and a spin 2 object with the ace of spades and queen of spades playing cards. Rotation by 360 and 180 degrees respectively reproduce the original appearance of these two objects. A spin 1/2 object requires a rotation of 720 degrees to reproduce the original appearance. Apart from a Moebius band such object can be constructed. However, it differs from the above mentioned playing cards by the fact that it has an internal mechanism operating on the original picture. It is thus somewhat different than the original two illustrations.

3:36PM F1.00014 Acoustic Attraction , ERIC OVIATT, KONSTANTINOS PATSIAOURIS, BRUCE DENARDO, Physics Department, Naval Postgraduate School — A sound source of finite size produces a diverging traveling wave in an unbounded fluid. A rigid body that is small compared to the wavelength experiences an attractive radiation force (toward the source). An attractive force is also exerted on the fluid itself. The effect can be demonstrated with a styrofoam ball suspended near a loudspeaker that is producing sound of high amplitude and low frequency (for example, 100 Hz). The behavior can be understood and roughly calculated as a time-averaged Bernoulli effect. A rigorous scattering calculation yields a radiation force that is within a factor of two of the Bernoulli result. For a spherical wave, the force decreases as the inverse fifth power of the distance from the source. Applications of the phenomenon include ultrasonic filtration of liquids and the growth of supermassive black holes that emit sound waves in a surrounding plasma. An experiment is being conducted in an anechoic chamber with a 1-inch diameter aluminum ball that is suspended from an analytical balance. Directly below the ball is a baffled loudspeaker that exerts an attractive force that is measured by the balance.

Friday, November 13, 2009 1:00PM - 3:48PM –
Session F2 High Energy/Nuclear Accelerators and Plasma Physics Spanagel 231

1:00PM F2.00001 Development of Mirrors for the CLAS12 High Threshold Cerenkov Counter[1] , EMMANUEL ANGULO, JOHN PRICE, CSU Dominguez Hills, YOURI SHARABIAN, Thomas Jefferson National Accelerator Facility — The Thomas Jefferson National Accelerator Facility (JLab) has begun an ambitious program to upgrade its beam energy from 6 GeV to 12 GeV. CLAS, one of the detectors at JLab, is being upgraded (to "CLAS12") to accommodate the higher energy. The existing Čerenkov counter in CLAS will be unable to distinguish electrons from pions at the higher beam energy, which necessitates the construction of a new, High-Threshold Čerenkov Counter (HTCC). An important part of the HTCC is the light collection system, which utilizes high-quality, extremely lightweight mirrors to reflect the Čerenkov light to a set of photomultiplier tubes located at the back of the detector. To ensure uniformity in performance, it is important to simplify as much as possible the construction of these mirrors. This talk will discuss the properties of CLAS12 and the HTCC, and will describe the technique to be used in the construction of the mirrors.

[1]Supported by a grant from the US DOE.

1:12PM F2.00002 LHC Status and Upgrade Challenges[1] , JEFFREY SMITH, SLAC National Accelerator Laboratory — The Large Hadron Collider has had a trying start-up and a challenging operational future lays ahead. Critical to the machine's performance is controlling a beam of particles whose stored energy is equivalent to 80 kg of TNT. Unavoidable beam losses result in energy deposition throughout the machine and without adequate protection this power would result in quenching of the superconducting magnets. A brief overview of the machine layout and principles of operation will be reviewed including a summary of the September 2008 accident. The current status of the LHC, startup schedule and upgrade options to achieve the target luminosity will be presented.

[1]Work supported in part by the U.S. Department of Energy contract DE-AC02-76SF00515.

1:24PM F2.00003 Identifying non-photonic electrons in Pb+Pb collisions with ALICE at the LHC , CHRISTOPHER BROWN, California Polytechnic State University, San Luis Obispo — One useful method for probing a quark-gluon plasma is through analysis of partonic energy loss, which is a direct indicator of the color charge density of the plasma medium. Electrons coming from the decays of heavy quarks, the so-called "non- photonic" electrons, should be sensitive to the differences in partonic energy loss for heavy and light quarks, and yet observations at RHIC suggest that they are as suppressed as light hadrons. This talk will overview the capabilities of the ALICE Experiment at CERN to detect non-photonic electrons, particularly emphasizing the performance of the Electromagnetic Calorimeter (EMCal), which will be used to investigate the flavor-dependence of partonic energy loss in Pb+Pb collisions at the LHC.

1:36PM F2.00004 Identification of bottom quark jets in Pb+Pb collisions in ALICE at the LHC , BRANDON BOSWELL, California Polytechnic State University — Partonic energy loss of high transverse momentum (pT) quarks and gluons in the Quark-Gluon Plasma has been inferred from the suppression of high pT hadrons observed in heavy ion collisions at RHIC. In order to learn more about the details of this energy loss, one would like to separately measure the effects on quarks and gluons. One way to do this is by identifying heavy quark jets through the semileptonic decay to electrons of bottom hadrons produced in the jet. This talk will show how results from the ALICE tracking system and electromagnetic calorimeter (EMCAL) can be used to identify heavy quark jets by identifying candidates containing electrons that satisfy a displaced vertex cut or those with large transverse impact parameter significance.

1:48PM F2.00005 Charged hadron spectra for Cu+Cu collisions at $\sqrt{S} = 22.4GeV$ with the STAR detector at RHIC[1] , ORPHEUS MALL, STAR Collaboration - UC Davis, STAR COLLABORATION — Identified charged particle spectra of $\pi\pm$, $K\pm$, p and $\bar{p}$ measured using energy loss in the STAR TPC are reported for $|y| < 0.1$ for Cu+Cu collisions at $\sqrt{S} = 22.4GeV$. Total particle production, particle ratios, and average transverse momenta, are presented for different collision centralities. These results are compared with previously published results from collisions of different systems at similar collision energies.

[1]This work is supported by a grant from the NSF.

2:00PM F2.00006 STAR as a fixed target experiment? , BROOKE HAAG, University of California, Davis/Hartnell College, DANIEL CEBRA, ROSI REED, University of California, Davis, STAR COLLABORATION — Collisions between gold or copper ions in the RHIC beam with aluminum nuclei in the beam pipe allow us to analyze fixed target interactions with the STAR detector at RHIC. These lower energy fixed target collisions may allow us to extend the low energy reach of the RHIC beam energy scan and possibly improve the chance of finding the critical point of the hadronic to quark matter phase boundary. In this talk, we will present preliminary results of spectra analysis for the fixed target collisions from various low energy test runs. Moreover, the viability of doing fixed target experiments with a collider detector will be discussed.

2:12PM F2.00007 Exact treatment of confinement in the semirelativistic Faddeev approach to three-quark problems , JOSEPH DAY, JOSEPH MCEWEN, ARNULFO GONZALEZ, ZOLTAN PAPP, California State University Long Beach, WILLIAM PLESSAS, University of Graz — The spin=1/2 elementary particles, the baryons, are mostly described as three-quark configurations. The quarks obey relativistic quantum mechanics. Their mutual interaction is modeled by infinitely rising potentials whose short-range nature is mediated by the exchange of Goldstone bosons. We solve the relativistic three-quark problem by using the Faddeev method. In the Faddeev method we break the wave function into components, and the components satisfies somewhat better integral equations. Nevertheless, the solution was not possible without approximating and violating the asymptotically rising potential. In this work we overcome this problem. We devised an approximation method, which allows the exact calculation of the Green's operator of an asymptotically rising potential with semirelativistic kinetic energy operator by using matrix continued fractions.

2:24PM F2.00008 Semi-Analytical Approach to the Gravitational Wave Signal From the Electroweak Phase Transition in General Standard Model-like Effective Potentials , JOHN KEHAYIAS, STEFANO PROFUMO, UC Santa Cruz — Upcoming gravitational wave (GW) detectors might detect a stochastic background of GWs possibly arising from bubble collisions and turbulence from a strongly first-order electroweak phase transition (EWPT). We investigate whether it is possible to connect, via a semi-analytical approximation to the tunneling rate of scalar fields with quartic potentials, the GW signal with the parameters entering the potential that drives the EWPT. We consider a finite temperature effective potential similar to the Higgs potential in the Standard Model (SM). In the context of a semi-analytic approximation to the three dimensional Euclidean action, we derive a general approximate form for the tunneling temperature and the relevant GW parameters. We explore the GW signal across the parameter space of the potential. We comment on the potential detectability of a GW signal with future experiments, and physical relevance of the associated potential parameters from extensions to the SM. In particular we consider singlet, triplet, higher dimensional operators, and top-flavor extensions to the Higgs sector of the SM. We find that the addition of a temperature independent cubic term in the potential, arising from a gauge singlet for instance, can greatly enhance the GW power. The other parameters have milder, but potentially noticeable, effects.

2:36PM F2.00009 The Search for Neutron Oscillations at Super-Kamiokande , MARK GREGG, California State University, Dominguez Hills/Particle Physics/Foundation — Neutron oscillations are predicted by theories that attempt to unify the fundamental forces of nature. This knowledge along with the enhanced sensitivity of the detectors used to observe neutron oscillations has increased interest in a search for this phenomenon. I, Mark Gregg, will be presenting research that is being conducted at California State University, Dominguez Hills involving the Super-Kamiokande nucleon decay detector and neutrino observatory and collaboration under the supervision of Dr. Kenneth Ganezer. This research consists of the work I have conducted along with my colleagues on the Monte Carlo program that simulates the physical events expected to be seen in the detector as a result of neutron oscillations. I will also describe the overall experiment and the latest results obtained by this experiment for lifespan and oscillation time lower limits of neutrons bound in oxygen nuclei and free neutrons, respectively.

2:48PM F2.00010 New results from ADMX – an ultra sensitive axion detection experiment , STEVEN J. ASZTALOS, LLNL and XIA LLC — Axions are hypothetical pseudoscalar particles that exist as a consequence of the Peccei-Quinn solution to the strong-CP problem. Light axions (ueV-meV) are also a natural cold dark matter candidate. One important detection technique is via resonant conversion to microwave photons in a high-Q cavity immersed in a strong magnetic field. In this class of experiment, the signal from the cavity is amplified by an ultralow noise amplifier, and mixed down to the audio frequency range using a double-heterodyne receiver. The power spectrum results by a Fast Fourier Transform, with the putative axion appearing as a narrow line at a frequency corresponding to its rest mass. This detection strategy provides the basis for the Axion Dark Matter eXperiment (ADMX) which has been taking data at Lawrence Livermore National Laboratory (LLNL) since 1996. ADMX has established limits in two distinct data channels - a medium resolution channel configured to search for "thermalized" axions and a high resolution channel for detecting axions that have recently fallen into the gravitational well of our galaxy. This talk will present an overview of the newly reconfigured experiment featuring an ultralow-noise first stage cryogenic SQUID amplifiers and present latest results from the two data channels.

3:00PM F2.00011 Development of a Compact Neutron Generator to be Used For Associated Particle Imaging Utilizing a RF-Driven Ion Source , YING WU, UC Berkeley — The development of a prototype compact neutron generator for the application of associated particle imaging (API) to be used for explosive and contraband detection will be presented. The API technique makes use of the 3.5 MeV alpha particles that are produced simultaneously with the 14 MeV neutrons in the deuterium-tritium (^{2}D(^{3}T,n)$^4\alpha$) fusion reaction to determine the direction of the neutrons and reduce background noise. This method determines the spatial position of each neutron interaction and requires the neutrons to be generated from a small spot in order to achieve high spatial resolution. In this work an axial type neutron generator was designed and built with a predicted neutron yield of 10^8 n/s for a 50 μA D/T ion beam current accelerated to 80 kV. It was shown that the measured yield for a D/D gas filled generator was $2\text{x}10^5$n/s, which scales to $2\text{x}10^7$ n/s if a D/T gas fill is used. The generator utilizes an RF planar spiral antenna at 13.56 MHz to create a highly efficient inductively coupled plasma at the ion source. Experimental results show that beams with an atomic ion fraction of $>$ 80% can be obtained with only 100 watts of RF power in the ion source. A single acceleration gap with a secondary electron suppression electrode is used in the acceleration column, to suppress secondary backscattered electrons produced at the target. Initial measurements of the neutron generator performance including the beam spot size and neutron yield under sealed operation will be discussed, along with suggestions for future improvements.

3:12PM F2.00012 Bound-Compton profiles for inelastic x-ray scattering in warm, dense matter[1] , PAUL DAVIS, University of California, Berkeley, GIANLUCA GREGORI, University of Oxford, JOE BRADLEY, JERRY SEIDLER, University of Washington, Seattle, PAUL NEUMAYER, Gesellschaft für Schwerionenforschung GSI, ROGER FALCONE, University of California, Berkeley, TILO DOEPPNER, JOE RALPH, SIEGFRIED GLENZER, Lawrence Livermore National Laboratory — Inelastic x-ray scattering has recently been developed as a powerful diagnostic method for determining the densities and temperatures of warm dense matter. Accurate measurements require determination of the spectral bound-free Compton profile. Thus, improved models of bound-free transitions are of great interest to correctly infer the inelastic scattering component from bound and free electrons, particularly in mid-Z systems. We present inelastic scattering spectra taken from un-shocked samples of Boron at the Advanced Photon Source (APS) synchrotron and laser-driven samples at LLNL's Titan laser. These spectra are compared with profiles calculated within the impulse approximation. These measured profiles provide an important tool for analyzing scattering in warm, dense systems. Additionally, they will be used as a benchmark for an improved self-consistent-field model of bound-free transitions currently in development.

[1]This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory.

3:24PM F2.00013 Spectrally Resolved X-ray Scattering from Implosion Targets , ANDREA KRITCHER, UC Berkeley, LLNL, TILO DOPPNER, LLNL, HAE JA LEE, UC Berkeley, SLAC, PAUL DAVIS, UC Berkeley, OTTO LANDEN, SIEGFRIED GLENZER, LLNL — Spectrally resolved x-ray Thomson scattering has been applied at the Omega Laser Facility to investigate the capsule adiabat of cone-in-shell targets. The technique of scattering from implosion targets was developed and tested for use as a diagnostic at the National Ignition Facility (NIF), LLNL. Measurement of the adiabat is applied to test low-adiabat pulse shaping methods, designed for optimum compressibility and stability. Theoretical equation of state models (EOS) can also be studied for conditions encountered during implosion. In these experiments, the noncollective, or microscopic behavior of the plasma, was probed with a Zn He-alpha x-ray source at a scattering angle of 113°. For these degenerate plasmas, the width of the inelastic scattering peak is proportional to the Fermi energy, and thus the electron density. The electron temperature is obtained from the measured intensities of the elastic and inelastic features. In-flight scattering measurements yielded electron densities of $\sim 1.2\text{x}10^{24}\text{cm}^{-3}$, temperatures of $\sim$10 eV, and an ionization state of C(+4)H(+1). This work was performed under the auspices of the DOE by LLNL under Contract No. DE-AC52-07NA27344, LDRD 08-ERI-003, and the Nat. Lab. User Fac. Prog.

3:36PM F2.00014 Evolution of Elastic X-ray Scattering in Laser-Shocked Warm Dense Li , NATHAN KUGLAND, University of California, Los Angeles, GIANLUCA GREGORI, University of Oxford, SUJIT BANDYOPADHYAY, Rutherford Appleton Laboratory, CERI BRENNER, University of Strathclyde, COLIN BROWN, Imperial College, The Blackett Laboratory, CARMEN CONSTANTIN, University of California, Los Angeles, SIEGFRIED GLENZER, Lawrence Livermore National Laboratory, FIDA KHATTAK, Kohat University of Science and Technology, ANDREA KRITCHER, CHRIS NIEMANN, University of California, Los Angeles, ANKE OTTEN, Technical University of Darmstadt, JAMES PASLEY, University of York, ALEX PELKA, MARKUS ROTH, Technical University of Darmstadt, CHRIS SPINDLOE, Rutherford Appleton Laboratory, DAVE RILEY, Queen's University, Belfast — Li foils were heated and compressed using shock waves driven by 4 ns long laser pulses. Separate 1 ns long laser pulses were used to generate a bright source of 2.96 keV Cl Ly-α photons for near-elastic x-ray scattering. Comparison with radiation hydrodynamics simulations shows that the plasma is highly coupled during the first several nanoseconds, then relaxes to a moderate coupling state at later times. Our main finding is that the near-elastic scattering amplitudes are quite sensitive to the mean ionization state $\overline{Z}$, and by extension to the choice of ionization model in the radiation-hydrodynamics simulations used to predict plasma properties within the shocked Li.

Friday, November 13, 2009 1:00PM - 4:12PM –

Session F3 Materials/Nanomaterials Science Spanagel 321

1:00PM F3.00001 Atomic and electronic structures of GaN:ZnO Alloys[1] , SHUZHI WANG, LIN-WANG WANG, Lawrence Berkeley National Laboratory — GaN:ZnO is a new class of alloy which currently holds the record for the efficiency of water photo-splitting. The mechanism of the large band gap bowing of this alloy and its detailed atomic structure, which are essential to understand the remarkable performance, however, are still not clear. We developed a model Hamiltonian describing the ab initio energies of different alloy atomic configurations and used it in Monte Carlo simulations to study the atomic structures of systems containing thousands of atoms. The equilibrium atomic structures from the MC simulations at different temperatures are then used to calculate their electronic structures. We found that at the experimental synthesis temperature of 1100 K, uniform alloy can be formed, albeit with a strong short range ordering. Consequently, their electronic structure is very different from the completely random alloy. Based on our calculation, we also predict that higher synthesis temperature can yield even lower energy band gap.

[1]Supported by Helios

1:12PM F3.00002 GW study of the half metallic band gap of zinc blende CrAs[1] , LIAM DAMEWOOD, CHING YAO FONG, UC Davis — We determined the semiconducting gap of zinc blende (ZB) CrAs within the GW approximation (GWA). This is the first GW calculation of a half-metal. Previous calculations using density functional theory within the generalized gradient approximation (GGA) determined a gap of 1.8 eV, but the GGA is known to give too small of a value for this quantity in semiconductors. Additionally, since ZB CrAs is a half metal, one of its spin channels behaves like a metal and changes the quasiparticle screening compared to the insulating case. Due to the local field effect, we only included the Γ-point term in the metallic channel calculation of the polarizability while keeping the full set of terms in the insulating channel GW calculation. Preliminary results suggest these terms from the polarizability produce little change in the value of the semiconducting gap when compared to the "full" GWA calculation.

[1]This research was supported in part by the National Science Foundation Grant No. ECCS-0725902 through TeraGrid resources provided by NCSA.

1:24PM F3.00003 Creating wide-band negative-index-of-refraction metamaterials with fractal-based geometry[1] , KEITH PENNEY, Cal State University East Bay — A burgeoning topic of modern research in electrodynamics and antenna design is the design and fabrication of "left-handed" metamaterials. This "left-handedness" is often created through use of an array of conductive structures with geometry appropriate for coupling on the wavelength scale with incident radiation to produce a phase-shifted reflected wave that cancels out incoming radiation and prevents transmission. This property has been demonstrated in several papers published in the last decade. In every instance, though the "left-handed" response is only exhibited in a small bandwidth centered about a specific frequency (bandwidth typically less that 0.1 GHz). I will show that through use of tessellated, fractal-based structures, one can create a repeatable geometry that exhibits a negative index of refraction (NIR) for multiple frequency bands, limited only by fabrication precision, with the ultimate goal being a wide-band absorptive response.

[1]CSU Faculty Support Grant

1:36PM F3.00004 Influence of Nanostructuring and Heterogeneous Nucleation on the Thermoelectric Figure of Merit in AgSbTe2 , PETER SHARMA, Sandia National Laboratories, JOSHUA SUGAR, DOUGLAS MEDLIN — Thermoelectric materials directly interconvert heat and electricity in the solid state. In some cases, nanoscale microstructures improve thermoelectric efficiency, but this phenomenon has rarely been studied systematically for precipitates in bulk materials. We quantified the influence of nanostructuring on the thermoelectric figure of merit (zT) by embedding Sb2Te3 inclusions, from nanometer to micron sizes, in an Sb-rich AgSbTe2 matrix through solid-state precipitation. Nucleation/growth and coarsening regimes of precipitate formation had a clear effect on transport properties, which could be understood using the effective medium theory of a two-phase composite. The majority of precipitates nucleated heterogeneously at grain boundaries and at planar defects found in the matrix phase, forming a complex interconnected network. This heterogeneous nucleation causes the precipitate/matrix system to follow effective medium theory even at small precipitate sizes, thus lowering zT. Therefore, heterogeneous nucleation is a major obstacle to zT improvement using nanoscale precipitates in bulk thermoelectrics.

1:48PM F3.00005 Electro-optical properties of quantum dots dispersed in chiral nematic liquid crystal[1] , J. KIRCHHOFF, Florida State University, R.H. INMAN, S. GHOSH, L.S. HIRST, University of California Merced — The electro-optical properties of quantum dots can be significantly altered if they are assembled in close proximity to each other. The partial ordering of liquid crystal molecules can be utilized to form directed quantum dot assemblies. Typically, this results in a red shift in the emission spectrum of the dots as the induced order leads to enhanced dipolar interactions, resulting in electronically coupled states. Spherical cadmium selenide quantum dots of different diameters are dispersed in various concentrations in a chiral nematic liquid crystal phase. The quantum dots are seen to aggregate, the sizes of the aggregates depend on the size and concentration of the dots as well as the mixing time. Optimum mixing times and quantum dot concentrations are determined for dots of different sizes to achieve a uniform quantum dot dispersion. Quantum dots with emission peaks ranging from 490 nm to 640 nm were studied using polarized optical microscopy and scanning microscopy photoluminescence measurements.

[1]Funding from NSF grants DMR-0852791 and DMR-0821771.

2:00PM F3.00006 Comparative analysis of the hydrogen-vacancy interaction in Mg and Al based on density functional theory[1] , LARS ISMER, A. JANOTTI, C.G. VAN DE WALLE, Materials Department, University of California, Santa Barbara, CA 93106-5050 — The interactions of vacancies (V) with atomic hydrogen (H) in the bulk of the metal are expected to play an important role in H-storage as well as H-embrittlement. Using density functional theory we have studied the H-V interactions in hcp-Mg and fcc-Al, two prototypic systems for H storage. We show that a single V can in principle host up to 9 H atoms in Mg and 10 in Al. In going beyond previous theoretical studies we further evaluate the concentration of the H-V complexes for different H loading conditions – ranging from low pressures to high pressures of H2 gas. We find significant differences between Mg and Al. In the case of Al, up to 15 % of H atoms are trapped in single vacancies even for very low H pressures, which strongly slows down the diffusion of H atoms. In the case of Mg, these trapping effects are negligible for low H pressures. However, vacancies containing multiple H atoms and H-induced superabundant vacancy formation are predicted to occur in Mg at much lower H loading pressures (about 1 GPa) than in Al (about 10 GPa).

[1]This work was supported by the U. S. DOE (Grant No. DE-FG02-07ER46434) and made use of the CNSI (NSF Grant No. CHE- 0321368) and the NSF-funded TeraGrid (Grant No. DMR070072N) computers.

2:12PM F3.00007 Strain-induced isosymmetric phase transition in multiferroic $BiFeO_3$, ALISON HATT, NICOLA SPALDIN, UC Santa Barbara, CLAUDE EDERER, Trinity College Dublin — We examine the effect of large epitaxial strain on multiferroic bismuth ferrite, $BiFeO_3$, using density functional calculations. We investigate a previously unidentified phase transition induced by experimentally accessible values of compressive strain. The transition occurs between phases that are isosymmetric yet have dramatically different structures and properties, the most notable of which is a strong enhancement and rotation of the electric polarization. This presents the opportunity to shift the transition boundary with an applied electric field, similar to a morphotropic phase boundary. Our work contributes to the limited body of knowledge about isosymmetric transitions and explains recent experimental reports of morphotropic phase boundary-like behavior in highly strained films of $BiFeO_3$ (Zeches *et al.*, *to appear* Science (2009)).

2:24PM F3.00008 Superparamagnetic Magnetite Nanoparticles for Optical Modulation/Chopping , SERKAN ZORBA, Whittier College, YADONG YIN, University of California, Riverside, WHITTIER COLLEGE/UC RIVERSIDE COLLABORATION — We demonstrate proof of concept operation of superparamagnetic magnetite nanoparticles and magnetite-TiO_2 peapod-superstructures for laser intensity optical modulation and chopping. The frequency of the modulation is shown to be twice that of the driving signal and a function of the size of the particles. Specifically, optical modulation with round nanoparticles of sizes 80, 130, 200 nm is compared with optical modulation with magnetite-TiO_2 peapod-superstructures of sizes of around 1 μm. The former gave rise to modulations of up to 2 kHz of frequency–a number comparable to that of the commercial optical choppers–, the latter up to 100 Hz. We also show that particle shape asymmetry and anisotropy enhance optical modulation.

2:36PM F3.00009 Phonon Transport in Graphene: Umklapp Quenching and Heat Conduction , ALEXANDER BALANDIN, University of California - Riverside, NANO-DEVICE LABORATORY TEAM — Since its exfoliation, graphene attracted tremendous attention of the research community. Graphene, which consists of a single atomic plane of carbon atoms, revealed many unique properties including extremely high electron mobility. In this talk I will show that unusual properties of graphene are not limited to electrons alone. Phonons also behave differently in two-dimensional (2D) system such as graphene. We have recently discovered experimentally that thermal conductivity of suspended graphene layers is extremely high and exceeds that of diamond or graphite [2-3]. We explained our results theoretically by considering the Umklapp and edge scattering of phonons in graphene [3]. Unlike in bulk graphite, the phonon transport in graphene is pure 2D for all phonon energies. As a result, the thermal conductivity of graphene can become extremely high. The extraordinary high thermal conductivity of graphene can be used for thermal management of nanoscale electronic devices. This work was supported by SRC-DARPA Functional Engineered Nano Architectonics (FENA) center and Interconnect Focus Center (IFC). [1] A.A. Balandin, et al. Nano Letters, 8, 902 (2008); S. Ghosh, et al., Appl. Phys. Lett., 92, 151911 (2008). [2] D.L. Nika, et al., Phys. Rev. B, 79, 155413 (2009); D.L. Nika et al., Appl. Phys. Lett., 94, 203103 (2009)

2:48PM F3.00010 Computational Approach for Quantifying Structural Disorder in Biomolecular Lattices , CLAYTON BRATTON, University of California, Davis - Physics, KAREN REISER, University of California, Davis - Neurosurgery, ANDRE KNOESEN, DIEGO YANKELEVICH, MINGSHI WANG, University of California, Davis - Electrical and Computer Engineering, ISRAEL ROCHA - MENDOZA, Cardiff University, Cardiff, Wales - Cardiff School of Biosciences — We have developed a novel computational approach for quantifying structural disorder in biomolecular lattices with nonlinear susceptibility based on analysis of polarization-modulated second harmonic signal. Transient, regional disorder at the level of molecular organization is identified using a novel signal-processing algorithms sufficiently compact for near real-time analysis with a desktop computer. Global disorder and regional disorder within the biostructure are assessed and scored using a multiple methodologies. Experimental results suggest our signal processing method represents a robust, scalable tool that allows us to detect both regional and global alterations in signal characteristics of biostructures with a high degree of discrimination.

3:00PM F3.00011 Studies of singly doping of Me and Fe in Si to deduce simple guidelines in selecting transition metal elements for Si-based spintronic materials , MICHAEL SHAUGHNESSY, UC Davis/LLNL, C.Y. FONG, RYAN SNOW, UC Davis, LIN YANG, LLNL — Single dopings of Mn and Fe in Si are investigated using 8-, 64-, and 216-atom supercells and a first-principles method based on density functional theory. Atomic sizes play an essential role in determining the contraction or the expansion of neighboring atoms around the transition metal element at a substitutional site. At a tetrahedral interstitial site, there is only expansion. Magnetic moments/transition-metal-element at the two sites are calculated. Physical reasons for these properties are given. Some guidelines for selecting transition metal elements doped in Si for future Si-based effective spintronic materials are proposed.

3:12PM F3.00012 Oscillation of the critical temperature in Proximity Systems involving Graphene Multilayers[1] , JULIUS DE ROJAS, ANDREAS BILL, California State University Long Beach — We consider a proximity system composed of a superconducting thin film onto which N graphene layers are grown. We calculate the Fermi energy and the density of states, and analyze the superconducting critical temperature T_c of the proximity system as a function of number of layers. We observe an oscillation of these quantities as a function of N that results from the size quantization effect. We also discuss the influence of an externally applied bias on the oscillatory behavior of the density of states at the Fermi level, and on T_c.

[1]We gratefully acknowledge support from the Research Corporation and from NSF Grant # 0907242.

3:24PM F3.00013 Faraday Effect in Magnetic and Non-Magnetic Colloidal Nanoparticles in Water , CONSTANTINE FARAH, SERKAN ZORBA[1], THOMAS MAXWELL, Whittier College, YADONG YIN[2], L. HE, M. YE, University of California Riverside — We have investigated Faraday Effect in a variety of nanoparticle solutions. Verdet constant of superparamagnetic nanocrystal clusters of magnetite (Fe3O4), diluted in water, is measured as a function of particle size. Particle sizes ranging from 3 to 210 nm, resulted in a nonlinear size dependence in Verdet constant. The relationship between Verdet constant and particle size is possibly due to variation in magnetic domain sizes within the particles. Domain size evolution investigations are underway using X-ray diffraction. Non-magnetic nanoparticle solutions investigated consisted of silver, silver oxide, magnesium oxide, nickel oxide, and carbon nanotubes. Solutions demonstrated diamagnetic and paramagnetic properties, as expected. We believe that Faraday Effect is an efficient method of investigating magnetic properties of nanoparticles.

[1]Prof. of Physics
[2]Prof. of Chemistry

3:36PM F3.00014 Computational study of the adsorption of methanol, formic acid, and formaldehyde on the β-SiC(100)-3x2 surface , LEKH ADHIKARI, SEAN CASEY, University of Nevada, Reno — The absorption of methanol, formic acid, and formaldehyde on the Si-rich β-SiC(100)-(3x2) surface has been studied using density functional theory (DFT) computational methods and small clusters to model the surface reactivity. A single cluster dimer model is used to calculate energies after the interaction of adsorbates on the surface. The dissociative adsorption of methanol on the SiC(100)-3x2 surface is predicted to take place facilely, giving rise to Si-OCH_3 and Si-H surface species and followed a path similar to that predicted for Si(100)-2x1 surface. The reaction is highly exothermic and predicted to occur with essentially no barrier. Formaldehyde is also predicted to adsorb with essentially no barrier on the SiC(100)-3x2 surface with formation of a 4-member ring on the surface. This adsorption is also exothermic and similar to the corresponding Si(100)-2x1 surface. This result shows that the carbonyl group can undergo cycloaddition onto the SiC(100) surface. Formic acid is also predicted to undergo dissociative chemisorption on the SiC(100) surface with the formation of Si-OCOH and Si-H surface species. This process is also highly exothermic (-283.1 kJ/mol) and essentially barrierless.

3:48PM F3.00015 Band-gap bowing, band offsets, and electron affinities for AlN, GaN, InN and InGaN: A DFT study[1] , POUL GEORG MOSES, CHRIS G. VAN DE WALLE, MAOSHENG MIAO, University of California Santa Barbara — AlN, GaN, and InN and their alloys are successfully being used in optical, electronic, and photovoltaic devices; a novel application is for photochemical water splitting. In order to further improve nitride-based devices a detailed understanding of the materials properties as a function of alloy composition is needed. To obtain such insight we have investigated the band gap and absolute band positions of AlN, GaN, InN and InGaN using density functional theory. The HSE exchange correlation functional has been used in order to accurately calculate the electronic band structure [1]. Detailed surface calculations have been performed that, combined with bulk calculations for alloys, yield information about the positions of valence and conduction bands on an absolute energy scale. We will discuss bowing effects, band offsets, and electron affinities in light of the application for photochemical hydrogen production.

[1] J. Heyd, G. E. Scuseria, and M. Ernzerhof, J. Chem. Phys. 118, 8207 (2003)

[1]Acknowledgment is made to the Donors of the American Chemical Society Petroleum Research Fund for support of this research, and to the CNSI, Teragrid.

4:00PM F3.00016 Strain effect in group-III nitride semiconductors and their alloys , QIMIN YAN, PATRICK RINKE, Materials Department, Univ. of California, Santa Barbara, MATTHIAS SCHEFFLER, Fritz-Haber-Institut der Max-Planck-Gesellschaft, Faradayweg 4-6, D-14195 Berlin, Germany, CHRIS VAN DE WALLE, Materials Department, Univ. of California, Santa Barbara — Strain plays a crucial role in group-III nitride semiconductor based devices since it affects the band structure near the valence- and conduction-band edges and thus the optical properties and the device characteristics. However, the deformation potentials that describe the change in band structure under strain have not yet been reliably determined. We present a systematic study of the strain effects in AlN, GaN and InN in the wurtzite phase. We apply density functional theory and hybrid functionals to address the band-gap problem. We observe nonlinearities of transition energies under realistic strain condition that may, in part, explain the appreciable scatter in previous theoretical work on deformation potentials of group-III-nitrides. For the linear regime around the experimental lattice parameters, we present a complete set of deformation potentials. Applying our deformation potentials, we study strain effects in InGaN alloys (including c-, m-, and semi-polar planes) grown on GaN substrates. We make predictions for the transition energies in these systems and their dependence on In composition.

Friday, November 13, 2009 1:00PM - 4:12PM – Session F4 Condensed Matter I Spanagel 421

1:00PM F4.00001 Imaging Transport in Nanowires with NSOM , LEE BAIRD, Naval Postgraduate School — A novel system has been developed for the imaging of carrier transport within semiconductor nanostructures by operating a near field scanning optical microscopy (NSOM) within a scanning electron microscope. Luminescence associated with carrier recombination is collected with high spatial resolution to monitor the motion and recombination of charge generated by use of an electron beam as an independent point source. Light is collected in the near field from a scanning fiber using tuning fork feedback in an open architecture combined AFM/NSOM system allowing for independent motion of sample and tip. From a single image, it is possible to obtain a direct measure of minority carrier diffusion length. This technique has been used in the near-field collection mode to image the diffusion of holes in n-type GaN-AlGaN core-shell nanowires, grown via Ni-catalyzed MOCVD. Measurements were made on tapered nanowires ranging in diameter from 500 to 800 nm, with lengths up to $\sim 30\mu m$. The average 1-dimensional carrier diffusion length was measured to be 1.2 +/- 0.2 μm in the low injection limit. In addition, it is possible to map the luminescence that is wave-guided to the end of the structure, imaging waveguide modes

1:12PM F4.00002 Little and Large:Topological Defects in Cosmology and Condensed Matter Theory , SINEAD GRIFFIN, Materials Research Laboratory, UC Santa Barbara, RAY RIVERS, Department of Physics, Imperial College London — Cosmology and condensed matter theory seem to be worlds apart, and yet are ubiquitously linked. Testing our current understanding of phenomena that occur on galactic scales can now be realized in the laboratory. The coming-together of cosmology and condensed matter theory is facilitated by the phase transitions and defect formation that is common to both areas. A recurring question in cosmology has concerned whether the vacuum is empty or contains vortex-strings or other topological defects. Understanding the formation and evolution of these topological defects plays a significant role in our understanding of cosmology and the early universe. Condensed matter systems provide an important starting point to studying the phenomena of phase transitions and the formation of topological defects. In both the cosmological and condensed matter scenarios, symmetry breaking causes a change to a degenerate vacuum manifold with non-trivial topology. This occurrence will be discussed along with experimental results in superfluid Helium and superconductors.

1:24PM F4.00003 Search for anomalous spin-mass coupling with a rubidium magnetometer[1] , IAN LACEY, L.R. JACOME, LOK FAI CHAN, SAHAR MUHSIN, California State University - East Bay, ALEC BOYD, Pomona College, ERIC BAHR, SRIKANTH GUTTIKONDA, DEREK KIMBALL, California State University - East Bay — We report on progress of our experiment using a dual-isotope rubidium magnetometer to search for a hypothetical long-range coupling between Rb nuclear spins and the mass of the Earth. The valence electron dominates magnetic interactions and serves as a precise co-magnetometer for the nuclei in a simultaneous measurement of Rb-85 and Rb-87 spin precession frequencies, enabling accurate subtraction of magnetic perturbations. The construction and optimization of the apparatus is nearly complete, and we are now addressing several technical sources of noise and studying potential sources of systematic error. The optimized dual-isotope Rb magnetometer has sufficient shot- noise-projected sensitivity to improve experimental limits on long-range spin-mass couplings by an order of magnitude in general and by two orders of magnitude for the proton spin in particular.

[1]Supported by NSF grant #0652824.

1:36PM F4.00004 Light Propagation in Liquid Crystals with a Chiral Dopant , JUSTIN LAWSON, KARL SAUNDERS, LOGAN GANTNER, California Polytechnic State University — This project will investigate the design and feasibility of a novel liquid crystal sensor that could be used to detect the presence and amount of foreign biological and/or chemical airborne agents. Such a sensor would have the advantage of being very portable. As such could have particular value in detecting biological or chemical weapons in the field of military operations. It would also be of use in a rapid response to a chemical or biological terrorist attack. The device would operate on the basic principal that when certain types of molecules bind to a liquid crystal molecule, the conformation of the liquid crystal molecule changes. This would in turn lead to a change in the overall arrangement of the liquid crystal, which could be detected using polarized light. In the absence of a contaminant the average molecular direction (optical axis, $\hat{n}$) is constant throughout the liquid crystal. The dopant adds a chirality or twist so that $\hat{n}$ precesses as a function of depth. We first solve for the reflected and transmitted light off of the air-liquid crystal boundary in the simplified case where there is linear chirality or a spiral configuration which repeats itself over some fixed interval (or pitch). We then generalize for cases in which this repeat distance varies with crystal depth. Finally we will obtain an expression for the contaminated crystal configuration which should depend on time and a diffusion constant and examine how the light properties change with respect to intensity and duration of exposure to the contaminant.

1:48PM F4.00005 Towards microwave modulation in a wavelength-tuned magneto-optical trap[1]

, AARON ALLEN[2], Clemson University, STEPHEN SEGAL[3], EVAN SALIM[4], MARIKA MEERTENS[5], DANA ANDERSON[6], JILA / University of Colorado-Boulder — In this project, I present a new method for trapping Rubidium-87 atoms. The method proposed is microwave modulation of an external cavity diode laser. The modulation is designed so as to produce frequency sidebands for hyperfine pumping in addition to the main cooling frequency. It is designed for use in magneto-optical trapping.

[1]Thanks to the NSF, JILA, The University of Colorado-Boulder, and the Physics REU program.
[2]undergraduate
[3]graduate student
[4]graduate student
[5]undergraduate
[6]Principal Investigator

2:00PM F4.00006 La-139 NMR in $La_4Ni_3O_8$: a possible analog to the cuprate high temperature superconductors

, NICHOLAS APROBERTS-WARREN, ADAM DIOGUARDI, ABIGAIL SHOCKLEY, NICHOLAS CURRO, UC Davis, VIKTOR POLTAVETS, MARTHA GREENBLATT, Rutgers University — The Ni^{1+}/Ni^{2+} states in the nickelates have identical electronic configurations as Cu^{2+}/Cu^{3+} in the high temperature superconducting cuprates ($3d^9/3d^8$), and may exhibit similar properties. However, the Ni^{1+} state is rare and cannot be easily stabilized. Recently, Martha Greenblatt and collaborators at Rutgers University have succeeded in growing a family of such compounds, $Ln_{n+1}Ni_nO_{2n+2}$with a layered structure similar to the cuprates. The $La_4Ni_3O_8$ compound is particularly interesting as it undergoes an antiferromagnetic transition at $T_N = 100$ K. We have done La NMR on powder samples to investigate the nature of this phase. Our spin lattice relaxation rate measurements clearly reveal a second order electronic phase transition similar to that observed in other antiferromagnets. Although we found clear signatures of changes to the spectra below T_N, we are unable to assign these changes to the presence of an internal field from the antiferromagnetic structure, or changes to the electric field gradient at the La site.

2:12PM F4.00007 Quantum Phases of Atom-Molecule Mixtures of Fermionic Atoms

, NICOLAS LOPEZ, SHAN-WEN TSAI, University of California Riverside — Cold atom experiments have observed atom-molecule mixtures by tuning the interactions between particles.[1] We study many particle interactions by examaning a simple model that describes the destruction of fermionic atom pairs to form single bosonic molecules and vice versa. A set of functional Renomalization Group equations[2,3] describing these processes are set up and solved numerically. The Self Energy of the fermions are attained as a function of frequency and we search for frequency dependent instabilities that could denote a transition from a disordered liquid to a BCS phase. (Financial support from NSF DMR-084781 and UC-Lab Fees Research Program.)

[1]M.L. Olsen, J. D. Perreault, T. D. Cumby, and D. S. Jin, Phys. Rev. A 80, 030701(R) (2009)
[2]R. Shankar, Rev. Mod. Phys., Vol 66 No. 1, January 1994
[3]S.W. Tsai, A.H. Castro Neto, R. Shankar, D.K. Campbell, Phys. Rev. B 72, 054531 (2005)

2:24PM F4.00008 Knight Shift Probe of Onset of Coherence in Heavy Electron Superconductor CeIrIn5

, ABIGAIL SHOCKLEY, NICHOLAS CURRO, University of California-Davis, ADAM DIOGUARDI, NICHOLAS APROBERTS-WARREN, PETER KLAVINS, UC-Davis — The $CeMIn_5$ compounds, where M = Co, Ir, Rh, are a novel class of superconductors discovered about 10 years ago. The 115 compounds are Kondo lattice materials: the compound's conduction electrons are coupled to an ordered lattice of local moments through the Kondo effect. These materials have a large effective electronic mass at low temperatures. We present new NMR Knight shift data in single crystals of CeIrIn5 between 2K and 120K. We find that the Knight shift of the In(1) site in this material is proportional to the bulk magnetic susceptibility above a temperature T* ∼ 30(?)K. Below this temperature, the Knight shift fails to track the susceptibility. We interpret these results in terms of the two-fluid model, in which the susceptibility of the heavy electron component, chi_cf, grows in intensity with decreasing temperature. We find that K_cf ∼ chi_cf ∼ log(T/T*), in agreement with other heavy fermion compounds. Our results confirm the predictions of the dynamical mean field theory calculations of Haule et al. for the onset of coherence in this compound.

2:36PM F4.00009 Cyclotron Resonance Vanishing effect in Correlated 2D Electron Systems

, ANDRE CHEBOTAREV, GALINA CHEBOTAREVA, PhysTech Lab Sunnyvale CA — "Cyclotron Resonance - Vanishing effect" (CRV) arise on magnetospectra of cyclotron resonance line (CR) as a well-defined gap that reduce to zero CR effect. CRV have been discovered due to experimental study of terahertz radiation transmission and photoresistivity magnetospectra at CR conditions in two-dimensional electron system (2DES) of GaAs/AlGaAs nanostructures with higher electron mobility at low (non-quantized Hall effect) magnetic fields. Unique experimental approach based on study of 2DES with photoresistivity and transmission techniques allows to get complementary data. One of the more significant results is that CRV-line shape (and consequently CRV effect) independent from testing THz power. We will discuss experimental study of "CR- Vanishing effect" and theoretical analysis that indicates on appearance of new fundamental correlated states of electrons at CRV conditions. To study CRV effect in detail we are working to create new model taking into account models for quantum Hall effect, magneto-plasma waves, non-linear zero-resistance states, and others that was develop for comparable experimental conditions.

2:48PM F4.00010 Steady-State and Transient Photoconductivity in the Poly(2,7-Carbazole) Copolymer PCDTBT, and in Bulk Heterojunction Composites with $PC_{70}BM$

, NELSON COATES, MING-HONG TONG, DANIEL MOSES, ALAN HEEGER, Physics, University of California, Santa Barbara, SERGE BEAUPRÉ, MARIO LECLERC, Chimie, Université Laval, RUSSELL GAUDIANA, Konarka Technologies Inc. — We have studied the nature of carrier generation in an alternating donor-acceptor low bandgap copolymer and in composites of that polymer with a soluble fullerene derivative, using steady-state and transient photoconductivity. The Poly(2,7-Carbazole) copolymer PCDTBT that we studied represents a class of donor-acceptor copolymers that hold promise for photovoltaic applications because of the ability to tune the electronic energy levels by changing the acceptor unit (see Blouin, N.; Michaud, A.; Leclerc, M. *Adv. Mater.* **2007**, 19, 2295 - 2300). Photovoltaic devices fabricated from PCDTBT in composites with the soluble fullerene derivative [6,6]-phenyl C70-butyric acid methyl ester ($PC_{70}BM$) have exhibited a higher solar cell power conversion efficiency than has been achieved in P3HT based devices. In PCDTBT, the absorption extends out to 700 nm, with two distinct but broad absorption bands that are centered at ∼400 nm and ∼600 nm. We have used steady-state and transient photoconductivity to investigate the carrier generation and collection efficiency of PCDTBT and its composite with $PC_{70}BM$ after photoexcitation at each of its distinct absorption bands.

3:00PM F4.00011 Superconducting Transition Temperature Dependence on c-axis Pressure in Single Crystal CeCoIn5

, SCOOTER JOHNSON, RENA ZIEVE, UC Davis, LOS ALAMOS NATIONAL LABORATORY COLLABORATION — In many layered superconducting compounds, including the high-Tc materials, the dependence of transition temperature on c-axis lattice constant indicates the importance of dimensionality for the superconductivity. We apply uniaxial pressure to single crystal samples of CeCoIn5 and monitor the shift in Tc with pressure. The sample is mounted between stainless steel pressure spacers within an ac susceptibility coil. This setup is located at the base of an Oxford helium dilution refrigerator modified specifically for uniaxial pressure measurements. We find that applied c-axis pressure initially shifts the onset of Tc to higher temperature. As pressure increases further, the onset Tc levels off and then decreases. The non-linear pressure dependence indicates an unusual sensitivity to uniaxial pressure, which may come from competition between dimensionality and overall hybridization effects.

3:12PM F4.00012 Local density of states and scanning tunneling currents in graphene[1] , LING YANG, University of California, Riverside, N.M.R. PERES, University of Minho, SHAN-WEN TSAI, University of California, Riverside — Graphene consists of an atom-thick layer of carbon atoms arranged in a honeycomb lattice and has been intensively studied due to its fascinating properties. We calculate the local density of states in graphene with different chemical substitution impurities, such as boron and nitrogen atoms, as well as for vacancies. We give exact analytical expressions for the local density of states for the whole energy range including energies beyond the Dirac cone approximation. The momentum maps of the local density of states for different impurities and discussion of their interpretation are given. We also present exact analytical calculations of scanning tunneling currents in locally disorded graphene using a multimode description of the microscope. [N. M. R. Peres, L. Yang, and S. - W. Tsai, New J. Phys. **11**, 095007(2009)]

[1]LY and SWT acknowledge financial support from NSF (DMR-0847801) and from the UC Lab Fees Research Progam.

3:24PM F4.00013 Arsenic nuclear magnetic resonance in CaFe2As2 , ADAM DIOGUARDI, NICHOLAS APROBERTS-WARREN, ABIGAIL SHOCKLEY, PETER KLAVINS, NICHOLAS CURRO, UC Davis — We present ^{75}As nuclear magnetic resonance measurements in the paramagnetic and antiferromagnetic states of $CaFe_2As_2$. Single crystals were produced using a Sn flux method and characterized via powder X-Ray diffraction, susceptibility, and specific heat measurements. The NMR data show that the internal hyperfine field and the electric field gradient change discontinuously at $T_0 = 169$ K. The observed hyperfine field is consistent with stripe antiferromagnetic ordering of the Fe spins in the a-b plane. Spin lattice relaxation data show metallic ${T_1}^{-1} \sim T$ for $T \leq T_0/3$. However, ${T_1}^{-1}$ shows a small peak at 10 K attributed to slow spin fluctuations that could indicate the emergence of antiferromagnetic domain wall motion.

3:36PM F4.00014 Growth of Iridium on Ge(111) Studied by STM and LEEM , CORY MULLET, SHIRLEY CHIANG, JAMES MORAD, ALICE DURAND, University of California, Davis — Iridium on germanium is a system which is useful for understanding the interaction of 5d metals with semiconductors, with potential applications to electronic contacts. We have used both scanning tunneling microscopy (STM) and low energy electron microscopy (LEEM) to characterize the submonolayer growth of iridium onto Ge(111) as a function of coverage, deposition temperature, and annealing temperature. Ir deposited onto the Ge(111) c(2x8) surface forms a $(\sqrt{3}\times\sqrt{3})R30^\circ$ phase with the island size dependent upon substrate temperature during deposition. Deposition at a sample temperature of 670 C yields large micron-sized regions of continuous $(\sqrt{3}\times\sqrt{3})R30^\circ$ coverage, as seen by LEEM. Deposition at 400 C produces Ir islands of three different sizes, all of which are too small to be resolved in LEEM but can be easily observed in room temperature STM images: large islands of roughly 10 to 20 nm diameter, consisting of multiple layers; medium-sized islands of roughly 4 nm in diameter, and small islands about 1 nm in diameter. Heating the sample over 640 C yields islands of large enough size to be resolved with LEEM, with the island size dependent upon annealing temperature. Ostwald ripening was observed in LEEM movies.

3:48PM F4.00015 A model of electron spin relaxation momentum time in GaAs cyclindrical quantum dots: including the Dresshaus effect , YUNG-SHENG HUANG, ISU University , Taiwan, JUNGSHENG HUANG, ISU University — A model of GaAs quantum dots embedded in a quantum wire is studied. We show that how the electron spin relaxation momentum time (SRT) is varying with some physical parameters. Under this model, a general conclusion is given : SRT decreases while the four parameters (external magnetic field, surrounding temperatures, quantum wire width and thickness) are increasing. The phenonmena is understood by more and more phonon modes resulted in a higher electron-phonon scattering probability when the system is under high magnetic field and high temperature. Thus the SRT is reduced. The most important reason for us to study such topics is that it is related with quantum information processing ability. In the present model, we deal with rectangular acoustic strain with deformation potential theory including the Dresshaus effect. Next step, we want to deal with how the SRT varies of quantum dots under very low temperature. A model of piezoelectric scattering with cyclindrical acoustic strain is considered in which the ionic displacement field (IDF) based on Born-Huang equation is shown. We are working on this line.

4:00PM F4.00016 Scanning Conductive Force Microscopy for Characterization of Model Molecular Devices , MARSHALL VAN ZIJLL, CHRISTOPHER FLEMING, GANG-YU LIU, SHIRLEY CHIANG — We have used scanning conductive atomic force microscopy as a tool to characterize molecular devices. Using self-assembled monolayers such as n-decanethiolate or n-octadecanethiolate as a matrix, we inlaid device components such as dendrimers or gold nanoparticles. All model systems were studied under constant force mode in air, while topography, lateral force, and current images were acquired. This configuration enables high resolution atomic force microscopy imaging, such as revealing of etch pits among the self-assembled monolayers, which is otherwise difficult to attain. In addition, the local conductivity can be correlated with the topographic features such as thiolate domains or surface defects. Both the technical development associated with this method and the detailed results will be discussed.

Saturday, November 14, 2009 2:00PM - 4:12PM –
Session S1 Applied Physics Spanagel 117

2:00PM S1.00001 Development of a Laminar Flame Test Facility for Bio-Diesel Characterization , GIAM TAN, NA — The relevance of applying testing standards established for diesel fuels to evaluate bio-diesel fuels motivates the design and fabrication of a vertical combustion chamber to be able to measure flame speeds of the varying strains of bio-diesel fuels and to attain more detailed kinetics information for biodiesel fuel. Extensive research is ongoing to understand the impact of fundamental combustion properties such as ignition characteristics, laminar flame speed, strain sensitivity and extinction strain rates on emission and stability characteristics of the combustor. It is envisioned that further flame studies will provide key kinetics validation data for biodiesel-like molecules – the current test rig was developed with provisions for optical access and for future spectroscopic measurements. The current work focuses on laminar flame speeds since this important parameter contains fundamental information regarding reactivity, diffusivity, and exothermicity of the fuel mixture. It has a significant impact upon the propensity of a flame to flashback and blowoff and also serves as a key scaling parameter for other important combustion characteristics, such as the turbulent flame structure, turbulent flame speed and flame's spatial distribution etc. The flame experiments are challenging as the tested bio-fuel must be uniformly atomized and uniformly dispersed.

2:12PM S1.00002 Low Temperature Transient Performance of Polymer Organic Light-Emitting Diodes[1] , KARL BURNETT, Naval Post Graduate School — Polymer Organic Light-Emitting Diodes (p-OLEDs) are conjugated polymers that conduct electric charges, enabling their use as semiconductors. Typical applications for p-OLEDs include high-resolution, high-efficiency displays, and when printed onto plastic substrates, thin and flexible patterned light sources such as vehicle dashboard displays and telephone keypads. We are investigating turn-on and turn-off transient effects in p-OLEDs that vary with temperature and the electrical driver. We have found that the turn-on transient is thermally activated, that light output is immediately proportional to current flow into the device, and that light emission continues from the device even after bias is removed. When these phenomena are fully characterized, they may explain transient effects seen in previous work, help describe the activation energies and rate kinetics in the device, and broaden the range of environments in which p-OLED devices may be used.

[1]Thesis Advisor: Dr. Nancy Haegel

2:24PM S1.00003 Trap States in Organic Semiconductor Thin Films using Photogenerated Currents , JORGE GUERRA, THOMAS GREDIG, California State University Long Beach, Dept. of Physics and Astronomy, 1250 Bellflower Blvd., Long Beach, CA 90840-3901 — Charge transport in semiconducting organic thin films for small molecules is strongly biased by the distribution of trap states present in the system. These trap states are mostly due to the inherently lower purity of small organic molecules and growth defects. Here, the trap states are explored and mapped using a time dependence study of photgenerated currents in thermally evaporated thin film copper phthalocyanine samples using the techniques described by Twarowski [1]. Although we use a different contact configuration and substantially thinner films than those used by Twarowski the method describes the system well up to first orders. The dependence of the recombination of photo-excited, dissociated charge pairs on the electric field also agrees with the Onsager mechanism [2] as predicted by Twarowski. We also explore the limitations of these models and discuss the potential of a more robust description for this type of system. This work is supported by NSF CAREER grant 0847552.

2:36PM S1.00004 Investigation on Novel Methods to Increase Specific Thrust in Pulse Detonation Engines via Imploding Detonations[1] , IVAN HO — Pulse Detonation Engines (PDE) is seen to be the next generation propulsion systems due to enhanced thermodynamic efficiencies. One of the limitations in fielding practical designs has been attributed to tube diameters not exceeding 5 inches, thus affecting specific thrust. Novel methods via imploding detonations were investigated to remove such limitations. During the study, a practical computational cell size was first determined so as to capture the required physics for detonation wave propagation using a Hydrogen-Air test case. Through a grid sensitivity analysis, one-quarter of the induction length was found sufficient to capture the experimentally observed detonation wave structure. Test case models utilizing axi-symmetric head-on implosions were studied in order to understand how the implosion process reinforces a detonation wave as it expands. This in effect creates localized overdriven regions, which maintains the transition process to full detonation. A parametric study was also performed to determine the extent of diameter increase for such that practical designs could be fielded. It was found in the study that diameters of up to 12 inches could be achieved with reasonable run length distances.

[1]This project is funded by Office of Naval Research.

2:48PM S1.00005 Simulation, Construction, and Experimental Evaluation of a Twice-Augmented Railgun , JUSTIN SALVIA, Naval Post Graduate School — Multi-rail augmentation is a simple method of improving railgun performance and achieving high projectile speeds from short railguns with moderate currents. Augmentation improves overall energy transfer efficiency by helping match the impedance of small railguns to laboratory power supplies. This paper presents the design and tests of a 50cm, easily assembled twice-augmented square-bore railgun. The design, consists of relatively thin, flat conductor and insulator plates held together with strong bolts. The plates to which the rear augmentation bolts are attached must be strong enough to withstand reaction forces that are transferred to the augmentation bolts when the projectile is launched. Prevention of surface electrical flash over across the thin insulator plates will be discussed. The 50-cm railgun reported here has accelerated 12-g projectiles to speeds greater than 1100 m/s with an overall efficiency of 8 percent; better performance is anticipated with further tests. The design is easily adapted to longer guns and larger bores. This design achieves higher speeds and better overall energy transfer efficiencies when compared to a 60-cm long gun with a single rail augmentation. Simulations of magnetic fields show that the field in the barrel is 39 percent higher for the 50-cm gun than for 60-cm gun at the same current. Simulations of the magnetic fields between the rails and the effect of rail configuration on performance will be discussed.

3:00PM S1.00006 NPS Gas Gun for Planar Impact Studies , CHIEN CHEONG HO[1], NA — The Naval Postgraduate School (NPS) commissioned a Gas Gun for shock wave studies on 9^{th} October 2009, by performing the first experiment. The Gas Gun is the key element of NPS Shock Wave Research Program within the Physics Department, where well-characterized planar impacts are essential for obtaining high quality data, to characterize a solid material. This first experiment was very successful, and returned key data on the quality of the impact conditions created. The Gas Gun is designed by SANDIA NATIONAL LABORATORIES, and the NPS spent twelve months fabricating the components of the Gas Gun and six months assembling the Gas Gun. Three inch projectile are launched at velocities up to 0.5 km/s, creating high pressure and temperature states that can be used to characterize the fundamental response of relevant materials to dynamic loading. The projectile is launched from a 'wrap around' gas breech where helium gas is pressurized to relatively low pressure. This gas is used to accelerate the projectile down a 3m barrel. Upon impact, the speed of the projectile and the flatness of the impact is measured, via a stepped circular pin array circuit. The next stage of development for the Gas Gun is to integrate a Velocity Interferometer System for Any Reflector (VISAR). The VISAR sees all the waves that flow through the target plate as a result of the impact. This is a key diagnostic for determining material properties under dynamic loading conditions.

[1]NIL

3:12PM S1.00007 Development of a Laboratory Scale Test Facility (LSTF) to investigate Armor solutions against buried explosive threats , FELIPE GARCIA, JOSE SINIBALDI, Naval Postgraduate School — This LSTF will address the effects of High Velocity Sand Blast Impact; massive overpressures, impulsive effects, kinetic energy and momentum, from developing the type of flat sand- loading profile required for code validation purposes. The background of this study is to generate a planar shock-wave profile and a flat-loading profile from high velocity sand and air blast onto intended flat-plate targets, to properly characterize the codes under development; to do this we propose to use a flyer plate, which is explosively driven, so, we end with a design in which a slanted flyer plate, with an explosive layer underneath it, is set-up and detonated from one end, as the detonation wave runs through the explosive layer, it pushes the flyer plate. If all the geometry is carefully designed and the flyer plate/explosive layers are precisely positioned, in theory we should be able to produce a flat flyer plate that travels on the order of 1 to 2 km/s towards a layer of sand, therefore generating a shock wave within the sand that will eventually accelerate the sand with a flat top-hat profile towards the intended target, thus achieving a flat sand loading profile onto the target. Success in this domain will allow ease of testing of advanced armor concepts against simulate buried explosive threats, thus providing validation for numerical codes that will be used to perform optimization of novel armor designs at low costs.

3:24PM S1.00008 Numerical Calculation of Anelastic Seismic Pulse Propagation in a Hysteretic Elastic Material Along a Horizontal Surface Boundary of the Earth , DAN KOSIK, Butler University — The stress-strain relation for materials such as soil and sand exhibit hysteretic elastic behavior and are modeled using the Preisach-Mayergoyz method for a numerical calculation of a propagating seismic pulse. The source pulse is taken to be the result of pressure applied to the inner surface of a cylindrical cavity in order to simulate a two dimensional dynamite source. The anelastic differential equation of motion that is solved does not include traditional nonlinear elasticity terms appropriate to materials with atomic elasticity, but contains the dominant anelastic terms appropriate to consolidated materials that exhibit hysteretic elastic behavior. For parameters characteristic of sand at the Earth's surface, a comparison of anelastic to linear seismic pulse propagation gives an anelastic pulse with much slower propagation speed than a corresponding linear pulse with evidence of dispersion in the pulse. The simulated ground roll that results shows dramatic differences between the anelastic and linear cases. These results have important implications for the detailed behavior of strong seismic waves moving in soft sediments. Their dominant frequencies, amplitudes, and methods by which they may be attenuated will depend on getting the detailed pulse structure and its propagation correct.

3:36PM S1.00009 Optimal Control of Shock Tube Flow via Water Addition with Application to Ignition Overpressure Mitigation in Launch Vehicles , NATHAN MOSHMAN, Naval Postgraduate School — Ignition Overpressure (IOP) in launch vehicles occurs at the start of ignition when a steep rise in pressure propagates outward from the rocket nozzle. It is crucial to minimize the overpressure so as to decrease risk of damage to the rocket body. Currently, CFD studies exist on this situation but there are no optimization studies of the water addition as a means to suppress the IOP. The proposed dissertation will use a numerical method to compute an approximate solution for an optimal control problem constrained by the one-dimensional Euler PDEs of fluid dynamics as well as volume fraction conservation. A model for inter-phase transport of mass momentum and energy and fluid interface quantities will be given. The control will be water addition from external nozzles. The adjoint system of equations will be derived and discretized. Necessary optimal conditions will be derived. An SQP method will solve an optimal situation. Predictions will be validated against shock tube experiments at the NPS rocket lab.

3:48PM S1.00010 Anomalous Velocity Dependence of the Friction Coefficient of an Air Supported Pulley , MATTEO CRISMANI, MICHAEL NAUENBERG, Physics Dept., UCSC — A standard undergraduate lab exercise to verify Newton's law, F = ma, is to measure the acceleration a of a glider of mass m suspended on an air track. In our experiment the glider is accelerated by a thin tape attached to the glider at one end, and to a weight of mass M at the other end. The weight hangs vertically via a pulley over which the tape is suspended by air pressure. In the absence of friction, the force pulling the glider is F = (M m/(M + m)g, where g is the acceleration of gravity. To the accuracy provided by the fast electronic timers (accurate to 1/10000 second) used in our experiment to measure the velocity and the acceleration of the glider, we verified that the friction due to the air track can be neglected. But we found that this is not the case for the friction due to the air pulley which adds a component -v/T to the force F on the glider, where T is the friction coefficient. We have measured the dependence of this coefficient on v, and found an excellent analytic fit to our data. This fit deviates considerable from the conventional assumption that 1/T is a constant and/or depends linearly on v.

4:00PM S1.00011 Instrumentation for Calorimetric Measurements of Strongly Correlated Electron Materials , ULISES URBINA, PEI-CHUN HO, Department of Physics, California State University, Fresno — A calorimeter is used to make measurements of the internal energy of a material in order to probe its thermodynamic properties such as crystalline lattice stiffness, electronic effective mass, phase transitions' and entropy. Rare-earth metallic compounds are of interest in our lab because they are known to exhibit strongly correlated electron behavior, which gives rise to interesting phenomenon such as conventional and unconventional superconductivity, metal-insulator transitions, magnetism and the magnetocaloric effect. Therefore, the temperature dependence of specific heat is an important quantity to investigate these materials. With limited space of our cryogenic system we are unable to use a traditional semi-adiabatic method, instead; we use a thermal relaxation method for our calorimetric measurements. A discussion on the construction of the calorimeter will be presented.

Saturday, November 14, 2009 2:00PM - 4:12PM –
Session S2 Nuclear/Atomic/Molecular Physics Spanagel 231

2:00PM S2.00001 The Neutron Induced Fission Fragment Tracking Experiment , JENNIFER KLAY, California Polytechnic State University San Luis Obispo, NIFFTE COLLABORATION — The Neutron Induced Fission Fragment Tracking Experiment will employ a novel, high granularity, pressurized time projection chamber (TPC) to measure ?ssion cross-sections of the major actinides to sub-1% precision. This talk will present an overview of the design of the NIFFTE TPC, current status of the project and why we believe this device may produce a renaissance in low energy nuclear physics experiments.

2:12PM S2.00002 NIFFTE Software and Computing: Results from the First Mock Data Challenge , RYUHO KUDO, California Polytechnic State University — The Neutron Induced Fission Fragment Tracking Experiment will employ a novel, high granularity, pressurized time projection chamber to measure fission cross-sections of the major actinides to sub-1% precision. The first suite of GEANT4 simulation and reconstruction software has been developed and run in a "mock data challenge" to validate the detector design and demonstrate the capabilities of the experiment. This talk will present the current status of results from this exercise, details for future simulation runs and plans for analysis of the first experimental data.

2:24PM S2.00003 CUORE: The Three Towers Test , LAURA SPARKS, ALISON GOODSELL, California Polytechnic State University San Luis Obispo, CUORE COLLABORATION[1] — Cryogenic Underground Observatory for Rare Events (CUORE) will be part of the next generation of detectors used to search for neutrinoless double beta decay (0vBB). Located in Assergi, Italy at the Gran Sasso National Laboratory (LNGS), CUORE will be a large cryogenic bolometer composed of 988 tellurium dioxide (TeO2) detectors with a total mass of 750 kg, and will search for 0vBB in 130Te. As the experiment will monitor the extremely rare event of 0vBB, all factors contributing to background need to be minimized to effectively increase the sensitivity. We assisted the LNGS researchers over the summer of 2008 by supporting Research and Development efforts to reduce the radioactive background of the experiment. Activities involved decontaminating the copper frame of radon daughters, and chemically etching and lapping the TeO2 crystals with nitric acid and silicon dioxide, respectively, to remove surface contaminants that contribute to background counts. This work was supported in part by NSF grant PHY-0653284 and the California State Faculty Support Grant.

[1]We are affiliated with but not members of the CUORE Collaboration.

2:36PM S2.00004 CUORE: Cryogenic Maintenance , ALISON GOODSELL, ROBIN REIL, California Polytechnic State Univ, San Luis Obispo, CUORE COLLABORATION[1] — CUORE (Cryogenic Underground Observatory for Rare Events) will be the largest detector used to investigate neutrinoless double beta decay in tellurium-130 (Te-130). Neutrinoless double beta decay has never been observed in nature. If detected, it would be a major scientific discovery indicating that the neutrino is its own antiparticle; this breakthrough would signal a fundamental revision to the Standard Model of physics. Located in Assergi, Italy at the Gran Sasso National Laboratory (LNGS), CUORE will be a cryogenic bolometer composed of 988 tellurium dioxide (Te02) crystals with a total mass of 750 kg. Over the summer of 2009, we traveled to the LNGS to assist the CUORE Collaboration by performing standard shifts for the Three Towers Test, a diagnostic experiment used to determine optimal hardware cleaning methods. This involved refilling the cryogenics system with liquid helium coolant to keep the crystal bolometers at an operating temperature of approximately 10 mK, and other routine tasks. This work was supported in part by the NSF RUI grant PHY-0653284.

[1]We are affiliated with, but not members of, the CUORE Collaboration.

2:48PM S2.00005 Introducing Accelerator Physics to a Wider Audience , ERNEST MALAMUD, University of Nevada, Reno — Over the last century, particle accelerators have changed the way we look at nature, and have become integral to the nation's technical infrastructure. Nevertheless, many non-scientists do not understand the term *accelerator*. And even within the broader physics community *accelerator physics* is not often taught as a course. The APS Division of Physics of Beams, to acquaint a wider audience with Accelerator and Beam Physics, recently published a 28-page brochure: **Accelerators and Beams, Tools of Discovery and Innovation**. Requests for copies have been quite wide ranging: policy makers; faculty for distribution to physics students and to raise awareness on campuses; APS staff to use in annual APS Teachers Days; and for a gifted high school student program. Copies are handed out by scientists presenting lectures on accelerators. And it is available at many labs, industries, education offices, libraries and public information offices. Nearly 12,000 copies have been printed. Most copies have been distributed and a new edition is being considered. I edited this brochure and am pleased with its success. In this talk I will run through highlights and will have copies available.

3:00PM S2.00006 Towards the first *ab initio* description of the deuterium-tritium fusion[1] , PETR NAVRATIL, SOFIA QUAGLIONI, LLNL — The deuterium-tritium reaction is important for the future fusion energy generation. It is used in laser-induced fusion at NIF and magnetic-confinement fusion at ITER. Even though it has been well studied experimentally, its first principles theoretical understanding is important. We are building a new capability to describe light-ion fusion reactions from first principles, known as *ab initio* NCSM/RGM approach [1,2]. We have completed a promising preliminary study of nucleon-nucleus scattering, particularly $n-^4$He scattering below the $d+^3$H threshold [1,2]. Now we are developing the deuterium-nucleus formalism that coupled with the nucleon-nucleus basis will allow us the first *ab initio* calculation of the ^{3}H(d,n)^{4}He fusion. We will present recent results and work in progress.

[1] S. Quaglioni and P. Navratil, Phys. Rev. Lett. **101**, 092501 (2008).
[2] S. Quaglioni and P. Navratil, Phys. Rev. C **79**, 044606 (2009).

[1]Prepared by LLNL under Contract DE-AC52-07NA27344. Support from the U.S. DOE/SC/NP (Work Proposal No. SCW0498), LLNL LDRD Grant No. PLS-09-ERD-020, and U. S. Department of Energy Grant DE-FC02-07ER41457 is acknowledged.

3:12PM S2.00007 Two-Body with Confining Potentials[1] , JOSEPH MCEWEN, JOSEPH DAY, ARNULFO GONZALEZ, ZOLTAN PAPP, California State University Long Beach, WHATEVER TEAM — A formalism is presented that allows an asymptotically exact solution of non-relativistic and semi-relativistic two-body problems with infinitely rising confining potentials. We consider both linear and quadratic confinement. The additional short-range terms are expanded in a Coulomb-Sturmian basis. Such kinds of Hamiltonians are frequently used in atomic, nuclear, and particle physics.

[1]Published in Springer Few Body Systems

3:24PM S2.00008 The Proof of the "Vortex Theory of Matter" , RUSSELL MOON, Dr, KONSTANTIN GRIDNEV, Pr, VICTOR VASILIEV, Dr — According to the Vortex Theory, protons and electrons are three-dimensional holes connected by fourth-dimensional vortices. It was further theorized that when photons are absorbed then readmitted by atoms, the photon is absorbed into the proton, moves through the fourth-dimensional vortex, then reemerges back into three-dimensional space through the electron. To prove this hypothesis, an experiment was conducted using a hollow aluminum sphere containing a powerful permanent magnet suspended directly above a zinc plate. Ultraviolet light was then shined upon the zinc. The zinc emits electrons via the photoelectric effect that are attracted to the surface of the aluminum sphere. The sphere was removed from above the zinc plate and repositioned above a sensitive infrared digital camera in another room. The ball and camera were placed within a darkened box inside a Faraday cage. Light was shined upon the zinc plate and the picture taken by the camera was observed. When the light was turned on above the zinc plate in one room, the camera recorded increased light coming from the surface of the sphere within the other room; when the light was turned off, the intensity of the infrared light coming from the surface of the sphere was suddenly diminished. Five other tests were then performed to eliminate other possible explanations such as quantum-entangled electrons.

3:36PM S2.00009 Hierarchical Cross-linked F-actin Networks: Understanding Structure and Assembly[1] , LINDA HIRST, University of California, Merced, LAM NGUYEN, Florida State University — The protein, F-actin provides us with an interesting system in which to investigate the assembly properties of semi-flexible filaments in the presence of cross-linkers. Recently it was observed that F-actin, in the presence of the cross-linker alpha-actinin at high molar ratios will generate a novel hierarchical network of filament bundles. We investigate this system using coarse-grained molecular dynamics (MD) simulation, confocal microscopy and x-ray scattering. We have studied the F-actin/alpha-actinin system in detail with different actin conc. (C) and alpha-actinin/actin molar ratios (gamma). Confocal microscopy and analysis shows that the assembled systems fall into one of 3 phases depending on C and gamma: (1) loosely connected network of F-actin and bundles, (2) loosely connected network of dense domains and (3) uniform network of bundles. This can be explained and replicated using MD simulation. We have also examined different types of cross-linkers to represent the proteins, fascin and filamin. Results show that phase formation is related to the flexibility in binding between F-actin and cross-linkers. This degree of freedom, possible with longer cross-linkers allows the formation of branch points and thus bundle networks.

[1]Funding - NSF CAREER award (DMR - BMAT)

3:48PM S2.00010 Measurement of Colloidal Interactions Using Holographic Microscopy and Multi-particle Scattering Theory[1] , KRISTOPHER ERIC MARTIN, University of California, Santa Barbara, JEROME FUNG, V.N. MANOHARAN[2], Harvard SEAS — Holographic microscopy provides the ability to record particle information in three dimensions with rapid time resolution. Lorenz-Mie scattering theory has been used to interpret holographic images of single colloids and provide highest available resolution for imaging single colloids in three dimensions. This method, however, has yet to be employed to interpret images of multiple particles. We demonstrate the implementation of a multiple-particle generalization of Lorenz-Mie scattering solution to interpret holographic images of clusters of spherical colloids. Highly precise theoretical holograms of multiple spherical colloids are calculated using the multiple-particle scattering theory, and recorded holographic images of colloidal clusters are fit to those of the theoretical method. The parameters of the fitting routine are used to characterize colloids' sizes, indices of refraction and separation radii, amongst other properties.

[1]NSF DMR-0649199, McNair Scholar Program
[2]Principle Investigator

4:00PM S2.00011 The nature of light , HOSSEIN KEIKHA — This article is a theory about the nature of light and the construction of nucleus, atoms and molecules. In this article, a model is suggested for the nature of light that defines all behaviours of light and it shows that it is not necessary for light to have dual behaviour.

Saturday, November 14, 2009 2:00PM - 4:24PM –
Session S3 Condensed Matter II Spanagel 321

2:00PM S3.00001 Quantum entanglement in photosynthetic light harvesting , MOHAN SAROVAR, AKIHITO ISHIZAKI, GRAHAM FLEMING, BIRGITTA WHALEY, University of California, Berkeley — Identification of non-trivial quantum mechanical effects in the functioning of biological systems has been a long-standing and elusive goal in the fields of physics, chemistry and biology. Recent progress in control and measurement technologies, especially in the optical spectroscopy domain, have made possible the identification of such effects. I examine light harvesting components of photosynthetic organisms – complex, coupled, many-body quantum systems – in which electronic coherence has recently been shown to survive for relatively long time scales despite the effects of their noisy environments. By constructing useful measures of entanglement for such systems, and using an accurate model of energy transfer dynamics in the presence of noise, I demonstrate the existence of quantum entanglement in a commonly studied light harvesting complex. The lifetimes and temperature dependency of entanglement are examined in detail. This study constitutes the first rigorous quantification of entanglement in a biological system.

2:12PM S3.00002 Analyzing Particle Size Effects in ZnS:Cu using X-ray Absorption Spectroscopy , SCOTT MEDLING, M. KOZINA, Y. JIANG, B. BALABAN, F. BRIDGES, S. CARTER, UC Santa Cruz — We report XAS measurements on ZnS:Cu,Mn phosphor materials of various particle sizes, 1-25μm. These materials exhibit electroluminescence (EL) at AC voltages of order 100V for $\sim$25μm particles, but only from small points associated with CuS nanoprecipitates (which form along the 111 plane in ZnS); here the local electric fields are enhanced by a factor of about 100. To enable lower-voltage applications, it is desirable to make smaller particles so devices can be thinner. We investigated the local structure for smaller particles produced by mill-grinding to determine why grinding leads to reduced AC EL. The K-edge EXAFS data show a decreased Cu-S first peak amplitude for the ground particle samples, but little change for Mn-S or Zn-S peaks. The XANES data show a large change in the structure of the Cu K-edge for smaller particles but not for either the host Zn or Mn dopant edges. Clearly grinding affects the environment about Cu, in the CuS precipitates, much more than the ZnS host lattice. Possibly the ZnS particles fracture preferentially through the CuS precipitates or the ZnS particles are partially sheared along the 111 plane.

2:24PM S3.00003 Metallic-like photoluminescence and absorption in fused silica surface flaws[1] , TED LAURENCE, JEFF BUDE, NAN SHEN, THEODORE FELDMAN, PHILIP MILLER, WILLIAM STEELE, TAYYAB SURATWALA, LLNL — Using high-sensitivity confocal time-resolved photoluminescence (PL) techniques, we report an ultrafast PL (40 ps-5 ns) from impurity-free surface flaws on fused silica, including polished, indented, or fractured surfaces of fused silica, and from laser-heated evaporation pits. This PL is excited by the single-photon absorption of sub-band gap light, and is especially bright in fractures. Regions which exhibit this PL are strongly absorptive well below the band gap, as evidenced by a propensity to damage with 3.5 eV nanosecond-scale laser pulses.

[1]This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract No. DE-AC52-07NA27344.

2:36PM S3.00004 Cooling and Heating Processes in the Magnetocaloric Materials: Is Reversibility possible? , ANA L. LIMA SHARMA, San Jose State University, ANGELO M. GOMES, CATALINA SALAZAR MEJIA, Universidade Federal do Rio de Janeiro, ADELINO A. COELHO, Universidade Estadual de Campinas — Irreversibility and reversibility of adiabatic processes in the magnetocaloric materials such as MnAs and $YbInCu_4$ have been a major concern for technological applications. We used a differential scanning calorimeter in order to record the heat flux as a function of the temperature and applied field. From the measured heat flux, we extracted the latent heat and entropy associated to cooling and heating processes. For materials with structural phase transition associated to magnetic ordering, we observed irreversibility of the thermodynamic cycle. On the other hand, for materials with valence transition, we observed a nearly reversible process. The thermomagnetic behavior can be understood as Zener's $p-d$exchange mechanism dominates for MnAs, i.e. the interaction range is weaker but long ranged, because the extended valence hole states mediate the ferromagnetic interaction.

2:48PM S3.00005 Comparative Study of PbS and CdSe quantum dots for use in Luminescent Solar Concentrators[1] , GEORGIY SHCHERBATYUK, RICHARD INMAN, University of California, Merced, School of Natural Scienses, CHUNHUA WANG, University of California, Merced, School of Engineering, SAYANTANI GHOSH, University of California, Merced, School of Natural Scienses, ROLAND WINSTON, University of California, Merced, School of Engineering — A comparative study for absorption, redshift and photovoltaic cell (PV) response has been performed for Luminescent Solar Concentrators (LSCs) with embedded PbS and CdSe quantum dots (QDs). LSCs are planar non-tracking devices where the incident solar radiation is absorbed by a fluorescent species embedded in a polymer or glass plate which down-convert and re-emit the solar radiation at longer wavelengths. The emitted light is trapped in the concentrator plate by total internal reflection, transported and emitted at the four edges, where the photons are collected by PV cells. Based on nearly double the current generated by PV cell to prototype device, we have concluded that for the purpose of embedding in the LSC PbS quantum dots outperform CdSe. The results are linked to smaller self absorption observed in PbS QD solution and broader absorption spectrum of these QDs.

[1]The work is funded by Abengoa, Shrink Nanotechnologies and NSF.

3:00PM S3.00006 The 1-d Long Range Diluted Heisenberg Spin Glass - A Monte Carlo Study[1] , AUDITYA SHARMA, PETER YOUNG, Department of Physics, UC Santa Cruz — We present results from a finite size scaling (FSS) analysis of Monte Carlo simulations on a novel long range diluted 1-d Heisenberg model with power law decay of interactions with distance. The advantage of studying a model like this combined with Heisenberg-like spins is that it allows one to study very large sizes (32000), and therefore reinforces the use of the FSS method to a) Study the existence of a phase transition. b) Extract the critical exponents of the phase transition. Besides allowing large sizes there are other advantages of studying this model: a) Real material spin-glasses are believed to be Heisenberg-like, and this is therefore directly relevant. b) By tuning the power of the decaying interactions we are able to study a range of universality classes from mean-field to short-range. Additionally we also present data to explore the role of Ising-like variables called chiralities which have been argued to be the drivers of the spin-glass transition. We find that our data does not support this spin-chirality decoupling scheme.

[1]NSF

3:12PM S3.00007 Optimization of a rubidium magnetometer based on nonlinear optical rotation , LOK FAI CHAN, L.R. JACOME, SRIKANTH GUTTIKONDA, ERIC BAHR, DEREK KIMBALL, California State University - East Bay — Atomic spin polarization of alkali atoms in the ground state can survive thousands of collisions with paraffin-coated cell walls. The resulting long spin-relaxation times achieved in evacuated, paraffin-coated cells enable precise measurement of atomic spin precession and energy shifts of ground-state Zeeman sublevels. In the present work, nonlinear magneto-optical rotation with frequency-modulated light (FM NMOR) is used to measure magnetic-field-induced spin precession for rubidium atoms contained in a paraffin-coated cell. We discuss optimization of the shot-noise-projected magnetometer sensitivity and practical implementation of the Rb magnetometer. The magnetometer will be applied to searches for anomalous spin-dependent interactions of the proton.

3:24PM S3.00008 Quantitative characterization of one-dimensional magnetic chains in organic semiconductors[1] , EVAN SILVERSTEIN, BRIAN J. CACHA, JOSHUA MIMS, THOMAS GREDIG, CSU Long Beach — Quasi one-dimensional iron chains are formed in thermally evaporated iron phthalocyanine thin films on silicon substrates. The chain length is modified by the substrate growth temperature and can be controlled within one order of magnitude. The surface morphology of organic thin films (80nm) is studied with atomic force microscopy. The grains are randomly oriented, have odd shapes, and are strongly elongated at high temperatures due to asymmetric shape of the small molecule. A height-height correlation function is applied to the data to extract the correlation length, roughness, and scaling parameter. A correlation between these structural characteristics and magnetic measurements performed in a vibrating sample magnetometer are presented.

[1]This work has been supported by the NSF CAREER grant no. 0847552.

3:36PM S3.00009 An electro-optic experimental study of an unusual liquid crystal phase transition , DANIEL STAINES, DEREK WICKS, AUSTIN HAVENS, JONATHAN FERNSLER, Cal Poly - San Luis Obispo — Liquid crystal phases are highly sensitive to their surroundings and they interact with light in unusual ways: the index of refraction is different depending on the polarization of the incident light. This combination of properties makes them ideal for low-power liquid crystal displays (LCD's), ubiquitous in today's portable electronic devices. They are also beautiful: optical textures of liquid crystals show bright colors, with the color corresponding to the amount of retardation in the light polarized along different axes. These phases are fluid, but can nevertheless be highly ordered. We have developed a novel experimental analysis using a photometric calculation of microscopy images to perform a series of experiments on several liquid crystal materials, called "de Vries" smectics. Using this system, we examined how the structure of these phases changed under the influence of different boundary conditions, temperature, and applied electric fields. These unusual materials show the bizarre behavior of appearing to become less ordered with decreasing temperature. This phase, which is not fully understood, has advantageous optical properties that could lead to the next generation of liquid crystal displays.

3:48PM S3.00010 Electronic structure and quantum critical behavior of $NbFe_2$, BRIAN NEAL, WARREN PICKETT, University of California, Davis — The C14 hexagonal Laves phase compound NbFe2 sits on the edge of a magnetic instability. By varying the composition, $Nb_{1-y}Fe_{2+y}$ encompasses two ferromagnetic states, a spin density wave state, and a quantum critical point (y = -0.04). Density functional calculations, using the generalized gradient approximation, found the electronic structure. An analysis of electronic structure calculations will be presented, illuminating the magnetic behavior and susceptibility at low temperature.

4:00PM S3.00011 Biologically inspired MEMS based directional microphone[1] , MICHAEL TOUSE, STEPHEN HARRISON, JEFFREY CATTERLIN, GAMANI KARUNASIRI, Naval Postgraduate School — A novel MEMS microphone is presented which mimics the aural system of the *Ormia ochracea* fly and its extraordinary directional sensitivity. To overcome the minimal separation between its ears, a flexible hinge mechanically couples the fly's two tympanic membranes. By comparing the frequency response of these two structures, the interaural differences are amplified and sound source information is processed with unparalleled speed and accuracy. The presented device is 2mm x 1mm x 10μm SOI, hinged at the middle and attached to the substrate using two narrow legs, allowing both rocking and bending modes. Along the edges of the membrane, two sets of interdigitated comb fingers are connected to an Irvine Sensors capacitive readout chip to allow electronic measurement of the displacement. Also presented are results of extensive finite element modeling performed using COMSOL Multiphysics, which are in close agreement with experimental data.

[1]This work is supported by NSF.

4:12PM S3.00012 Environment-invariant measure of distance between evolutions of an open quantum system , MATTHEW GRACE, Department of Scalable Computing Research & Development, Sandia National Laboratories, JASON DOMINY, Program in Applied & Computational Mathematics, Princeton University, ROBERT KOSUT, SC Solutions, Inc., CONSTANTIN BRIF, HERSCHEL RABITZ, Department of Chemistry, Princeton University — The problem of quantifying the difference between evolutions of an open quantum system is important in quantum control, especially in control of quantum information processing. Motivated by this problem, we develop a measure for evaluating the distance between unitary evolution operators of a composite quantum system that consists of the sub-system of interest and environment. The main characteristic of this measure is the invariance with respect to the effect of the evolution operator on the environment, which follows from an equivalence relation that exists between unitary operators acting on the composite system, when the effect on only the sub-system of interest is considered. The invariance to the environment's transformation makes it possible to quantitatively compare the evolution of an open quantum system and its closed counterpart. The distance measure also determines the fidelity bounds of a general quantum channel with respect to a unitary target transformation. As an example, the measure is used in numerical simulations to evaluate fidelities of optimally controlled quantum gate operations, in the presence of an environment.

Saturday, November 14, 2009 2:00PM - 4:00PM –
Session S4 Gravitation Physics Spanagel 421

2:00PM S4.00001 Yang-Mills Field from Quaternion Space Geometry, and its Klein-Gordon Representation , ALEXANDER YEFREMOV, Institute of Gravitation and Cosmology, Moscow, Russia, VIC CHRISTIANTO, Sciprint.org, FLORENTIN SMARANDACHE, University of New Mexico, Gallup Campus — Analysis of covariant derivatives of vectors in quaternion (Q-) spaces performed using Q-unit spinor-splitting technique and use of SL(2C)-invariance of quaternion multiplication reveals close connexion of Q-geometry objects and Yang-Mills (YM) field principle characteristics. In particular, it is shown that Q-connexion (with quaternion non-metricity) and related curvature of 4 dimensional (4D) space-times with 3D Q-space sections are formally equivalent to respectively YM-field potential and strength, traditionally emerging from the minimal action assumption. Plausible links between YM field equation and Klein-Gordon equation, in particular via its known isomorphism with Duffin-Kemmer equation, are also discussed.

2:12PM S4.00002 Einstein's Gravity as an Emergent Local Gauge Tetrad/Spin Connection Field , JACK SARFATTI, Internet Science Education Corporation — Einstein's 1915 General Relativity with curvature but no torsion is a local gauge theory of the abelian 4-parameter translation subgroup of the non-compact Poincare group. The gauge potentials are the four "Dirac square root" tetrads not the Levi-Civita field that is bilinear in the 16 tetrad components and their first partial derivatives. Since the tetrads are Lorentz 4-vectors, the basic gravity field is spin 1 and is, therefore, renormalizable. The spin 2 metric field is composite. The analogy with electroweak-strong nonabelian compact Lie group gauge theories becomes apparent when the full Poincare group is locally gauged adding a dynamically independent torsion field to the curvature field. A unification of post-inflation emergent Einstein gravity with the strong force of quantum chromodynamics is also apparent in the tetrad formulation. The tetrad fields are analogous to the superfluid flow field that is the gradient of a ground state coherent multi-valued Goldstone phase.

2:24PM S4.00003 An Educational Look at an alternative to the Expanding Universe Model , RICHARD KRISKE, University of Minnesota — The author often toys with an alternative view to the expanding universe model and believes it would be a good way to teach the Scientific method. In the author's (R.M. Kriske) model the red shift is a result of magnifying the horizon of a 4 dimensional surface. On a two dimensional surface such as the earth the horizon is not maginifiable since things on the surface naturally tilt away from the observer in every direction and everything is transformed into a curved line (the Horizon) (the students can verify this as a globe can be used with some pins in it-for example). Likewise one would expect this signature of curvature to show up on three curved space dimensions, and instead of pins, a perpendicular time dimension. As the observer looks toward the pins they tilt away from him/her and in four dimensions this means they are accelerating away from him/her even though the globe is standing still. At each point a pair is being produced with its attendant gamma ray emission, but the points are of course seen as accelerating away, simply due to the curvature of the globe and nothing else, resulting in a red shift. This author produced model has never been suggested before and never presented to the Scientific community. The students would then need to compare this to the current simpler model that point sources accelerating away from the observer undergo a redshift due to the Doppler Effect. The Students would then have to review these models and determine the size of the globe for the amount of red shift seen from the two competing models. One model has a cut- off mode, since the pins not only tip backward in the curved space model but are also cut off. How does this cut-off show up, is it simply dimming, and can an experiment be done for it? The last step of this exercise is to see if one could tell the difference between these models, and if a mixed model is better, since the Globe could also be expanding (Of course the instructor could also ask what the result would be if the globe where contracting).

2:36PM S4.00004 Gravity Driven Universe , ROY MASTERS, Individual — Space is the flowing property of global gravity, spinning primal matter spontaneously with gravitational space and time. Gravity is the unifying background field. Gravity flows from its singularity with the big bang equivalent of a big whoosh. Curving with rotational angular precession as the winding of a ball of string, one flowing dimension becomes a shimmering three-dimensional sphere. Time with local gravitation appears with curvature at flux points where particles swirl and spin like eddies from a stream. In the absence of spin, global gravitation is collisionless and bidimensional: Its infinite scalar potential manifesting only where the background spins current-resisting curvatures as local gravitational/time. All gravitational mass drags in the unifying background field, and relative slowness through the common current is momentum without entropy. Furthermore, gravity as spin/mass is simultaneously the first and second electromagnetic fundamental force. Gravitational spin begets magnetic attractions under gravitational compression. Through fusion come the strong/weak forces completing the hydrogen atom. Gravitation's first sustained spin is the infinitely invariable particle upon which the universe is built.

2:48PM S4.00005 Standing gravitational waves from domain walls[1] , DOUGLAS SINGLETON, California State University, Fresno, MERAB GOGBERASHVILI, Andronikashvili Institute of Physics, SHYNARAY MYRZAKUL, Gumilev Eurasian National University — We construct a plane symmetric, standing gravitational wave for a domain wall plus a massless scalar field. The scalar field can be associated with a fluid which has the properties of "stiff" matter, i.e., matter in which the speed of sound equals the speed of light. Although domain walls are observationally ruled out in the present era, the solution has interesting features which might shed light on the character of exact nonlinear wave solutions to Einstein's equations. Additionally this solution may act as a template for higher dimensional "brane-world" model standing waves.

[1]MG and DS were each support by separate 2008-2009 Fulbright Scholars Grants.

3:00PM S4.00006 A WKB-like approach to Unruh radiation , ANDREA DE GILL, DOUGLAS SINGLETON, California State University, Fresno, VALERIA AKHMEDOVA, Institute of Theoretical and Experimental Physics, Moscow, TERRY PILLING, North Dakota State University, Fargo — Unruh radiation is the thermal flux seen by an accelerated observer moving through Minkowski spacetime. In this article, we study Unruh radiation as tunneling through a barrier. We discuss the metric of the observer that constantly accelerates in vacuum, usually called the Rindler observer, and discuss some of its subtleties. To obtain the tunneling rate and the temperature of the Unruh radiation, we use a WKB-like method. This derivation should be accessible to advanced undergraduate students or beginning graduate students. In addition, this gravitational WKB method helps to highlight some fine points of the WKB method as usually applied in quantum mechanics. First, the tunneling rate strictly should be written as the closed path integral of the canonical momentum. Second, for the case of the gravitational WKB problem, there is a time-like contribution to the tunneling rate arising from an imaginary change of the time coordinate upon crossing the horizon. This temporal contribution to the tunneling rate has no analog in the ordinary quantum mechanical WKB calculation.

3:12PM S4.00007 New Perspective on the Cosmological Constant Problem , VESSELIN GUEORGUIEV — A multiverse approach to the Cosmological Constant Problem (CCP) is considered. It is assumed that each member of the multiverse ensemble has a characteristic scale a that can be used as integration variable in the partition function. An averaged characteristic scale of the ensemble is estimated by using only members that satisfy the Einstein field equations. The averaged characteristic scale is compatible with the Planck length when considering an ensemble of solutions to the Einstein field equations with effective cosmological constant near the quantum filed theory value (of the order of the Planck vacuum energy density $\tilde{\Lambda} \approx 8\pi$ in Planck units). For universes with characteristic scale of the order of the observed universe $a \approx 8 \times 10^{60}$ the cosmological constant $\Lambda = \tilde{\Lambda}/a^2$ is within few orders of magnitude of the observed value.

3:24PM S4.00008 Causal Dynamical Triangulations in 3+1 Dimensions , RAJESH KOMMU, UC Davis — I will be discussing the Causal Dynamical Triangulations (CDT) approach to quantum gravity in 3+1 dimensions. CDT is a non-perturbative approach defined as a state sum over causal geometries. I will talk about some important properties of this model, including the role of causal structure and discuss results I have been able to verify, including the multiple phases exhibited by the model, the large and small scale dimensions of the space-time, and the emergence of a classical space-time.

3:36PM S4.00009 Quasilocal Energy in FRW Cosmology[1] , MARCUS AFSHAR, Univ. of California at Davis — I present a calculation of the quasilocal energy of a generic FRW model of the universe. The results have the correct behavior in the small-sphere limit and vanish for the empty Milne universe. Higher order corrections are found when comparing these results to classical calculations of cosmological energy. This case is different from others in the literature chiefly in that it involves a non-stationary spacetime. This fact can be used to differentiate between the various formulations of quasilocal energy. In particular, the formulation due to Brown and York is compared to that of Epp. Only one of these is seen to have the correct classical limit.

[1]arXiv:0903.3982

3:48PM S4.00010 Understanding Dark Energy , HOWARD GREYBER — By careful analysis of the data from the WMAP satellite, scientists were surprised to determine that about 70% of the matter in our universe is in some unknown form, and labeled it Dark Energy. Earlier, in 1998, two separate international groups of astronomers studying Ia supernovae were even more surprised to be forced to conclude that an amazing smooth transition occurred, from the expected slowing down of the expansion of our universe (due to normal positive gravitation) to an accelerating expansion of the universe that began at at a big bang age of the universe of about nine billion years. In 1918 Albert Einstein stated that his Lambda term in his theory of general relativity was ees,"the energy of empty space," and represented a negative pressure and thus a negative gravity force. However my 2004 "Strong" Magnetic Field model (SMF) for the origin of magnetic fields at Combination Time (Astro-ph0509223 and 0509222) in our big bang universe produces a unique topology for Superclusters, having almost all the mass, visible and invisible, i.e. from clusters of galaxies down to particles with mass, on the surface of an ellipsoid surrounding a growing very high vacuum. If I hypothesize, with Einstein, that there exists a constant ees force per unit volume, then, gradually, as the universe expands from Combination Time, two effects occur (a) the volume of the central high vacuum region increases, and (b) the density of positive gravity particles in the central region of each Supercluster in our universe decreases dramatically. Thus eventually Einstein's general relativity theory's repulsive gravity of the central very high vacuum region becomes larger than the positive gravitational attraction of all the clusters of galaxies, galaxies, quasars, stars and plasma on the Supercluster shell, and the observed accelerating expansion of our universe occurs. This assumes that our universe is made up mostly of such Superclusters. It is conceivable that the high vacuum region between Superclusters also plays a role in adding extra repulsive gravity force. Note that cosmologist Stephen Hawking comments on his website that "There is no reason to rule out negative pressure. This is just tension."