Joint Fall 2012 Meeting of the Texas Sections of the APS, AAPT, and Zone 13 of the SPS
Lubbock, Texas
http://www.aps.org/meetings/meeting.cfm?name=TSF12
benefit society as a whole. Academic-Industry approach for a more effective translational research. A series of examples will be presented with emphasis in the measures.

Industry requires new generations of (industrial) physicists in such sectors as semiconductor, energy, space, life sciences, defense and advanced manufacturing. This work presents an industry perspective about the role of Physics in economic development and the need for a collaborative Academic-Industry approach for a more effective translational research. A series of examples will be presented with emphasis in the measure-

frequently translates into new discoveries and innovations that have direct impact in society (e.g. Proton Cancer Therapy). Some of the described.

On behalf of the CMS Collaboration

8:50AM A1.00003 Answering Dirac’s Challenge: Practical Quantum Mechanics for Materials 1. JAMES CHELIKOWSKY, University of Texas at Austin — Over eight decades ago, after the invention of quantum mechanics, P. A. M. Dirac made the following observation: “The underlying physical laws necessary for the mathematical theory of a large part of physics and the whole of chemistry are thus completely known, and the difficulty is only that the exact application of these laws leads to equations too complicated to be soluble. It therefore becomes desirable that approximate practical methods of applying quantum mechanics should be developed, which can lead to an explanation of the main features of complex atomic systems...” The creation of “approximate practical methods” in response to Dirac’s challenge has included the one electron picture, density functional theory and the pseudopotential concept. The combination of such methods in conjunction with contemporary computational platforms and new algorithms offer the possibility of predicting properties of materials solely on the basis of the atomic species present. I will give an overview of progress in this field with an emphasis on materials at the nanoscale.

1 Support from the DOE and NSF is acknowledged.

8:00AM A1.00001 Welcome —

9:25AM A1.00004 Transient Plasma Physics: Nanosecond Pulsed Power Applied to Energy, Engines, and Other Things 1. SCOTT PENDLETON, University of Southern California — Plasma in a formative state prior to equilibration of the electron energy distribution, (referred to here as “transient plasma”), is studied for improvement of engine efficiency in various types of fuel-burning engines. Ignition by transient plasma has demonstrated substantially reduced ignition delay, and shows promise for improving engine efficiency through improved combustion efficiency. This transient plasma persists for only a short time, and requires for operation short (<100ns) pulsed high voltage, and typically small pulse energy (10mJ to <1J). It thus requires nanosecond-time scale pulsed power. The plasmas, combined with the subsequent combustion, provide a rich physics. Results for studies of several varied engine types including internal combustion engines and pulse detonation engines will be reviewed. Experiments and modeling to determine the physics and some ideas for future directions will be presented. In addition, some other diverse applications for nanosecond pulsed power will be briefly described.

1Supported by the Air Force Office of Scientific Research, the Office of Naval Research, NumerEx Inc., the NSF, and the TCC Corp.

On behalf of the CMS Collaboration

10:30AM B1.00001 The Important Role of Physics in Industry and Economic Development , IGOR ALVARADO, National Instruments Corp. — Good Physics requires good education. Good education translates into good Physics professionals. The process starts early with Science, Technology, Engineering and Mathematics (STEM) education programs for Middle and High-School students. Then it continues with competitive higher education programs (2 years and 4 years) at colleges and universities designed to satisfy the needs of industry and academia. The research work conducted by graduate students in Physics (and Engineering Physics) frequently translates into new discoveries and innovations that have direct impact in society (e.g. Proton Cancer Therapy). Some of the major and largest scientific experiments in the world today are physics-centered (e.g. Large Hadron Collider-LHC) that generate employment and business opportunities for thousands of scientists, academic research groups and companies from around the world. New superconducting magnets and advanced materials that have resulted from previous research in physics are commonly used in these extreme experiments. But not all physicists will end up working at these large high-energy physics experiments, universities or National Laboratories (e.g. Fermilab); industry requires new generations of (industrial) physicists in such sectors as semiconductor, energy, space, life sciences, defense and advanced manufacturing. This work presents an industry perspective about the role of Physics in economic development and the need for a collaborative Academic-Industry approach for a more effective translational research. A series of examples will be presented with emphasis in the measurement, control, diagnostics and computing capabilities needed to translate the science (physics) into innovations and practical solutions that can benefit society as a whole.
11:05AM B1.00002 NMR/MRI blood flow magnetization equation in the rotating frame of reference- Part I. DILIP DE¹, Kaduna State University, Kaduna, Kaduna State, Nigeria — This paper describes thoroughly the need and the method of deriving the first of its kind the NMR/MRI blood flow magnetization (y component) equation in the rotating frame when rf $B_1$ field is applied along laboratory X direction. The equation is expected to serve as the mother equation for accurate non-invasive blood flow quantification through all NMR/MRI experiments. It is shown how Awowojogbe’s equation of blood flow magnetization can be obtained from above equation under assumption of constant $B_1$ field and $v_y = 0$. The method of deriving the equation can be applied to modify Bloch-Torey Diffusion MRI equation to include relaxation times and flow and also to derive the NMR/MRI spin flow magnetization equation in the laboratory frame of reference. The derivation of the corresponding flow equation for longitudinal component of magnetization will be discussed in a separate paper.

¹The research is in the area of application of NMR/MRI for noninvasive blood flow estimation.

11:17AM B1.00003 Plasma Relaxation Parameters From High Power Microwave Excitation¹. STERLING BEESON, GEORGE LAITY, ANDREAS NEUBER, Texas Tech University — The recombination/relaxation physics of plasma generated from a 3 MW, 3μs pulse-width, high power microwave (HPM) pulse is investigated. This pulse is incident on a microwave transparent dielectric window which separates the source (vacuum) environment from the atmospheric test chamber (pressure and gas type are user controlled). During the pulse, the value of $E/p$ (normalized electric field value with pressure) are sufficiently large such that plasma is formed on a time scale of 100 ns after which the plasma begins to absorb and reflect a significant amount of the power. The electron densities are on the order of $10^{13}$-$10^{14}$ cm$^{-3}$ for pressures of 10 to 400 torr in air, $N_2$ and argon environments. At these densities, the plasma attenuates the pulse on the order of -40 to -10 dB during peak electric fields. With the use of multi-standard waveguide couplers, a CW low power (a few watts) probing signal is injected into the waveguide structure. Utilizing a 1D plasma model and the transmitted power levels, the temporal evolution of the electron density after the HPM pulse is determined for many microseconds after the pulse. The technique was confirmed by benchmarking with known attachment rates in an air environment along with the 2-body recombination rate of $N_2$. This research helps facilitate the understanding of which molecular/atomic species exist during plasma formation from HPM excitation.

¹Research supported by an AFOSR Grant on the Basic Physics of Distributed Plasma Discharges along with a SMART student fellowship supported by the U.S. Army.

11:29AM B1.00004 Energy Efficient Tunnel Transistors Using Dielectric-Gated Band Engineered Tunnel Junctions¹, JUNG WOO, IMAN REZANEJAD, RUSTY HARRIS, Department of Electrical and Computer Engineering, Texas A&M University — Low stand-by power in transistors can be improved with steep sub-threshold tunnel transistors. This is supported by the U.S. Army. 13 The temporal evolution of the electron density after the HPM pulse is determined for many microseconds after the pulse. The technique was confirmed by benchmarking with known attachment rates in an air environment along with the 2-body recombination rate of $N_2$. This research helps facilitate the understanding of which molecular/atomic species exist during plasma formation from HPM excitation.

¹Thanks to National Science Foundation (Grant Nos. #0618242 and #0901699) for financial support.

11:41AM B1.00005 Diffusion MRI/NMR magnetization equations with relaxation times, DILIP DE, Kaduna State University, Kaduna, Kaduna State, Nigeria, SIMON DANIEL, Mathematics Dept., Kaduna State University, Kaduna, Kaduna State, Nigeria — Bloch-Torrey diffusion magnetization equation ignores relaxation effects of magnetization. Relaxation times are important in any diffusion magnetization studies of perfusion in tissues(Brain and heart specially). Bloch-Torrey equation cannot therefore describe diffusion magnetization in a real-life situation where relaxation effects play a key role, characteristics of tissues under examination. This paper describes derivations of two equations for each of the y and z component diffusion NMR/MRI magnetization (separately) in a rotating frame of reference, where rf $B_1$ field is applied along x direction and bias magnetic field($B_0$) is along z direction. The two equations are expected to further advance the science & technology of Diffusion MRI(DMRI) and diffusion functional MRI(DFMRI). These two techniques are becoming increasingly important in the study and treatment of neurological disorders, especially for the management of patients with acute stroke. It is rapidly becoming a standard for white matter disorders, as diffusion tensor imaging (DTI) can reveal abnormalities in white matter fibre structure and provide models of brain connectivity.

11:53AM B1.00006 Modification of Richardson-Dushman Equation, variation of thermionic emission constants, temperature variation of workfunction in metals, DILIP DE, Kaduna State University, Kaduna State, Kaduna, Nigeria, MATHIAS AJAEROH IKECHUKWU, Department of Physics, University of Abuja, Abuja, Nigeria — For proper modeling of the thermionic converters and evaluation of efficiency and power output (from given input energy flux) it is necessary to estimate accurately the thermionic currents from the hot emitter surface. In this paper we derive the expression for the work function of a metal as a function of temperature considering thermal expansion and constant number of free electrons. We then modify the Richardson-Dushman equation for thermionic emission and explain the variation of the Thermionic emission constant from metal to metal. This theory of modification of Richardson-Dushman thermionic equation is quite different from that of Seely (1941) and explains better the observed temperature rate of change of work function of tungsten and the variation of thermionic emission constants from metal to metal.
10:00AM B2.00001 The Utilization of HOPG based Graphene for a less costly and efficient replacement of platinum in Dye-Sensitized Solar Cells (DSC's) , MATTHEW P. PUSKO, Stephen F. Austin State University — Dye-Sensitized Solar Cells (DSC) are also known as Graetzel cells after their inventor, Michael Graetzel, who invented them in 1991. DSCs are potential alternatives to the more conventional and expensive semiconductor p-n junction solar cells like silicon solar cells. In a Graetzel cell, light is absorbed by a sensitizing dye which is coupled to a wide band gap semiconductor (TiO2). Electric charges are liberated by the photon induced electron injection from the dye molecules into the conduction band of the semiconductor. The use of sensitized TiO2 in conjunction with the semiconductor oxide permits the absorption of a large portion of the terrestrial solar spectrum with near 10% conversion efficiency. In the "traditional" DSC, platinum metal is used as one of the counter electrode materials. In our research, graphene of various forms (from HOPG in specific) is utilized instead of costly platinum to replace the counter-electrode in the DSC's. HOPG also known as Highly Oriented Pyrolytic Graphite is being used to dry deposit graphene layers onto glass or FTO.

10:42AM B2.00002 Solution Processed Graphene for Utilization in Thin Films , JONATHAN BELEW, Stephen F. Austin State University — Solution processing of graphene offers a method for increasing the purity and uniformity of the deposited thin films. Solubility parameters are useful in preparing dispersions and have been employed successfully with CNTs. Applying solubility parameters and solution processing techniques to graphene provides an avenue for both higher purity samples and more uniform thin films. The solubility of graphene families of solvents has different solubility parameters and careful selection of these parameters will help the quality of dispersions. Vacuum filtration and density centrifugation allow for filtering of the material, while annealing films is known to fix defects and improve structure. Through filtration, film deposition, and thermal annealing, graphene thin films of higher purity and uniformity will lead to graphene thin films that have the theoretical properties closer to ideal single crystal graphene. These properties have major applications in the fields of solar power and organic light emitting diodes as transparent electrodes and electron donor material.

10:54AM B2.00003 Programming Mathematica to find normal mode frequencies for a system with a large number of degrees of freedom , GREGORY BEUHLER, CHRIS MURRELL, BRETT CASWELL, HUNTER CLOSE, Texas State University-San Marcos — Imagine a system of N masses alternating with N+1 springs in a line between two walls, with all motion constrained to the line. This system has N normal modes, each with its own frequency. Using our basic knowledge of programming principles, we developed a program in Mathematica that allowed us to generate the frequencies of these normal modes for any value of N, including large N. In this talk we present the specific strategy, structure, and products of the program. In particular, we defined a function for filling matrices and used nested loops to extract relevant data. In a companion talk, we present physical arguments for patterns we observed in the sets of frequencies.

11:06AM B2.00004 Graphene Anode Organic Light Emitting Diode , COLLIN TIMMONS, Stephen F. Austin State University — The mechanical and electrical properties of graphene make it a preferred replacement for the rare metal Indium in transparent electrodes. Research into replacing indium tin oxide with graphene is being conducted at Stephen F. Austin State University. This talk will be an overview of the graphene anode OLED and the challenges of starting OLED research at SFA.

11:18AM B2.00005 Using new graphics and physical arguments to make sense of frequencies of large-N normal mode systems , CHRIS MURRELL, BRETT CASWELL, GREGORY BEUHLER, HUNTER CLOSE, Texas State University-San Marcos — Imagine a system of N masses alternating with N+1 springs in a line between two walls, with all motion constrained to the line. This system has N normal modes, each with its own frequency. In a companion talk, we present how we used Mathematica to generate the frequencies of these normal modes, no matter how large N is. In this talk, we describe patterns we found in the frequencies, we explain physically why these patterns should be expected, and we generalize our physical arguments to further abstract our understanding of symmetry.
11:30AM B2.00006 Student Internships: a low-risk, high-yield learning experience
Catherine Schiber, Texas State University-San Marcos — Internships can be valuable in increasing confidence in learning new skills and techniques for real world research. I did a ten-week internship program at Oak Ridge National Laboratory (ORNL) for the Department of Energy (DOE) through the Science Undergrad Laboratory Internship (SULI) program. I was assigned to the Spallation Neutron Source (SNS) division, where I worked peripherally on an accelerator. Within SNS, I was in the Research Accelerator Division (RAD), which worked with the accelerator beam before it hit the target and spalled neutrons. The first part of my project involved collecting and managing a database of possible accelerator beam size changes by solving a pre-existing model. The second part was putting that database into an interpolation program. However, I had no programming experience, and therefore had to learn on the job. I learned Python by reading books, doing online tutorials, and asking occasional questions. By the end of the project, I had written a program in both Python and JRuby that included a graphic user interface (GUI) and customized error messages. Therefore, I encourage all students to take part in an internship, even if it is not in their field of expertise.

11:42AM B2.00007 Investigations of High-energy Gamma Rays through Cherenkov Radiation in Atmosphere
Jonathan Clark, John Sandy, Chris Cowden, Nural Akchurin, Texas Tech University — High-energy gamma rays from various sources interact with the atmosphere resulting in electromagnetic showers. Relativistic charged particles from the core of electromagnetic showers emit Cherenkov radiation which is highly directional and polarized. The size, temporal properties, as well as polarization of the Cherenkov radiation incident on the earth’s surface reveal some of the fundamental properties of an incident gamma ray. The GEANT4 simulation package is used to model the electromagnetic showers resultant from gamma rays interacting with the atmosphere. We later analyze the collected data to estimate the signal generated by Cherenkov photons by an array of photo-multiplier tubes (PMTs). Our goal is to explore the feasibility of using the Cherenkov polarization information to improve measurements of high-energy cosmic gamma rays by optimizing the configuration of an array of PMTs.

11:54AM B2.00008 Investigation of thermal transmission across AlN/Si boundaries
Elizabeth Carlisle, Adam Simpson, Tim Head, Abilene Christian University — We investigate transmission of non-equilibrium ballistic phonons generated in a Cr absorption layer across 1 micron c-axis oriented AlN films and the interface with (111) oriented Si substrates. Using phonon imaging techniques we verified good thermal conductance across the AlN/Si interface.

12:06PM B2.00009 Separating Cherenkov and Scintillation Pulse Signals in High Energy Electromagnetic Calorimeters
John Sandy, Christopher Cowden, Jon Clark, Nural Akchurin, Texas Tech University — We propose to adapt techniques from the field of signal processing to distinguish between Cherenkov and scintillation light present in high energy electromagnetic calorimeters, such as those employed at LHC detectors. Relativistic charged particles emit Cherenkov radiation when they traverse a medium with a velocity higher than the phase velocity of light in that medium. Some materials commonly employed in high energy physics calorimetry emit scintillation light when a charged particle passes through it. Presently in calorimeters which use these scintillating materials, one cannot always separate the Cherenkov light from the scintillation light in the measured signal even though some techniques exist. Separating the two light signals from a single material requires a large divergence in the time structure or in the wavelength spectra of Cherenkov and scintillation light. This study intends to move from the time domain of the signal into the frequency domain where we split the measured signal and return to the time domain with separate estimates of the Cherenkov and scintillation light signals.

12:18PM B2.00010 Overview of the Use of Graphene in Electric Double Layer Capacitors
Arthur Coleman, Stephen F. Austin State University — Advances in the manufacture and optimization of Electric Double Layer Capacitors or ultra-capacitors may make them a good alternative to batteries. Using graphene in the EDLC layers seems to limit the high self-discharge and voltage loss on discharge that plagues ultra-capacitors.

Friday, October 26, 2012 10:30AM - 12:06PM
Session B3 Biological & Chemical Physics
Holiday Inn Towers Heritage - Chair: Kelvin Cheng, Trinity University and Texas Tech University

10:30AM B3.00001 Ergosterol and Stigmasterol Interact with Phosphatidylcholine Lipid Bilayers Less Favorably Than Cholesterol
Serkan Balymez, Juyang Huang, Texas Tech University — The maximum solubility of sterol in a lipid bilayer is the highest mole fraction of sterol that can be incorporated into a lipid bilayer before sterol precipitates from the bilayer to form crystals. A higher maximum solubility indicates more favorable interactions between the sterol and lipid bilayer. In this study, the maximum solubilities of ergosterol and stigmasterol in DOPC and DSPC lipid bilayers were measured using light scattering and confocal confirmed using optical microscopy. We found that correlation function of scattering intensities from two independent detectors can be used to sensitively determine the solubility limits of sterols. The validity of our new technique was confirmed by measuring the solubility limit of cholesterol in DOPC and DSPC lipid bilayers. We found that the maximum solubilities of ergosterol and stigmasterol are higher in PC lipid bilayers with saturated chains (DSPC) than that in PC bilayers with unsaturated chains (DOPC). Compared with cholesterol, ergosterol and stigmasterol both have much lower solubility limits in PC lipid bilayers. Our results suggest that minor differences in sterol structure could result in large differences in sterol-PC interactions.

10:42AM B3.00002 Effect of Hybrid Lipid on Line Tension in Lipid Membranes
Ede Baykal-Caglar, Juyang Huang, Texas Tech University — Giant unilamellar vesicles (GUVs) made of at least three components, one being cholesterol, one a high-melting-point lipid and one a low-melting-point lipid, can exhibit coexisting liquid ordered - liquid disordered (lo-ld) phases. The energy per unit length of boundary is called line tension and it depends on the temperature of the system according to power law and vanishes at critical temperature. Universal scaling behavior can help us to understand the phase behavior of many different systems. Systems in the same universality class represent similar collective behavior in phase transitions apart from their physicals details. Critical exponents characterize the continuous phase transition of systems, and all systems belonging to a universality class will have the same critical exponents. In this work, we measured the critical exponent related to line tension using fluorescence microscopy and image processing. We investigated the effects of hybrid lipid on line tension and critical exponent. One chain of hybrid lipid is saturated and the other one is unsaturated, because of which they behave as linacants and can reduce the line tension. We prepared GUVs with three different compositions: DOPC/DSPC/Cholesterol 30:45:25, DOPC/DSPC/POPC/Cholesterol 22.5:45:25:7.5, DOPC/DSPC/POPC/Cholesterol 15:45:55:25. Our results show that the critical exponent associated with line tension gradually increase with hybrid lipid concentration. Having different values of critical exponent in different mixtures indicate that lipid bilayers cannot be classified as a universality class.
10:54AM B3.00003 Gramicidin Alters the Lipid Compositions of Liquid-Ordered and Liquid-Disordered Membrane Domains. EBRAHIM HASSAN-ZADEH, Graduate Student, JUYANG HUANG, Professor — The effects of adding 1 mol % of gramicidin A to the well-known DOPC/DSPC/cholesterol lipid mixtures were investigated. 4-component giant unilamellar vesicles (GUV) were prepared using our recently developed Wet-Film method. The phase boundary of liquid-ordered and liquid-disordered (Lo-Ld) coexisting region was determined using video fluorescence microscopy. We found that if care is not taken, light-induced domain artifacts can significantly distort the measured phase boundary. After testing several fluorescence dyes, we found that the emission spectrum of Nile Red is quite sensitive to membrane composition. By fitting the Nile Red emission spectra at the phase boundary to the spectra in the Lo-Ld coexisting region, the thermodynamic tie-lines were determined. The viscosity of [Bmim][PF$_6$] at high temperatures from 353 K to 283 K and near T$_g$ from 203 K to 196 K can be fit by a single VFT equation. In the temperature range of our measurements, the rotational diffusion of these probes in [Bmim][PF$_6$] can be fit by a single VFT equation. Rotation of probes in the temperature range 6 to 4 K near glass transition is investigated by conducting probe rotational diffusion experiments on rubrene and tetracene in [Bmim][PF$_6$] using the fluorescence recovery after photobleaching (FRAP) technique. Rotational anisotropy decays for the probes in the temperature range T$_g$–6 to T$_g$+4 are well described by the stretched exponential function. The stretching parameter is found to be constant for both probes with $\beta_{\text{tetracene}} = 0.71$ and $\beta_{\text{rubrene}} = 0.88$. The viscosity of [Bmim][PF$_6$] at high temperatures from 353 K to 283 K and near T$_g$ from 203 K to 196 K can be fit by a single VFT equation. In our temperature measurements, the rotational diffusion of these probes in [Bmim][PF$_6$] is decoupled from structural relaxation with a rotational correlation time following a fractional Debye-Stokes-Einstein (DSE) relation.

10:54AM B3.00005 The effects of bariatric surgeries on type 2 diabetes mellitus. JIA LERD NG, ROBERTO ORTIZ, TYLER HUGHES, Texas A&M University, MICHEL ABOU GHANTOUS, OTHMANE BOUHALI, Texas A&M University — We consider a scientific mystery which is of central importance in treating the most rapidly emerging national and global health threat: type 2 diabetes mellitus. The mystery involves a surprising effect of certain bariatric surgeries, and specifically Roux-en-Y gastric bypass (RYGB), a procedure which bypasses most of the stomach and upper intestine. An unanticipated result is that RYGB is usually found to contribute within only a few days to glucose homeostasis. This means the surgery can immediately cure patients even before they start losing weight. We are investigating this wondrous biochemical response with a quantitative model which includes the most important mechanisms. One of the major contributors is glucagon-like peptide 1 (GLP-1), an incretin whose concentration is found to increase by a large amount right after the RYGB surgical procedure. However, our results, in conjunction with the experimental and medical data, indicate that other substances must also contribute. If these substances can be definitively identified, it may be possible to replace the surgery with pharmaceuticals as the preferred treatment for type 2 diabetes.

1This work was supported by the Qatar Foundation through the Qatar Biomedical Research Institute, and by the Science Program at Texas A&M University at Qatar.

11:06AM B3.00004 Dynamic Heterogeneity in Ionic Liquids near and below the Glass Transition: Rotational Diffusion of Probes in 1-Butyl-3-methylimidazolium Hexafluorophosphate. FEHMI BARDAK, JUSTIN R. RAJIAN, LARRY G. HINES, RICHARD A. BARTSCH, EDWARD L. QUITEVIS, Texas Tech University — Dynamic heterogeneity in the ionic liquid, 1-butyl-3-methylimidazolium hexafluorophosphate ([Bmim][PF$_6$]) (T$_g$ = 196 K) near glass transition is investigated by conducting probe rotational diffusion experiments on rubrene and tetracene in [Bmim][PF$_6$] using the fluorescence recovery after photobleaching (FRAP) technique. Rotational anisotropy decays for the probes in the temperature range T$_g$–6 to T$_g$+4 are well described by the stretched exponential function. The stretching parameter is found to be constant for both probes with $\beta_{\text{tetracene}} = 0.71$ and $\beta_{\text{rubrene}} = 0.88$. The viscosity of [Bmim][PF$_6$] at high temperatures from 353 K to 283 K and near T$_g$ from 203 K to 196 K can be fit by a single VFT equation. In our temperature measurements, the rotational diffusion of these probes in [Bmim][PF$_6$] is decoupled from structural relaxation with a rotational correlation time following a fractional Debye-Stokes-Einstein (DSE) relation.

11:18AM B3.00006 A general method for modeling biochemical and biomedical response. ROBERTO ORTIZ, JIA LERD NG, TYLER HUGHES, Texas A&M University, MICHEL ABOU GHANTOUS, OTHMANE BOUHALI, Texas A&M University at Qatar, ABDELIYAH ARREDOUANI, Qatar Biomedical Research Institute, ROLAND ALLEN, Texas A&M University — The impressive achievements of biomedical science have come mostly from experimental research with human subjects, animal models, and sophisticated laboratory techniques. Additionally, theoretical chemistry has been a major aid in designing new drugs. Here we introduce a method which is similar to others already well known in theoretical systems biology, but which specifically addresses biochemical changes of the human body resolved to medical interventions. It is common in systems biology to use first-order differential equations to model the time evolution of various chemical concentrations, and we as physicists can make a significant impact through designing realistic models and then solving the resulting equations. Biomedical research is rapidly advancing, and the technique presented in this talk can be applied in arbitrarily large models containing tens, hundreds, or even thousands of interacting species, to determine what beneficial effects and side effects may result from pharmaceuticals or other medical interventions.

1This work was supported by the Qatar Foundation through the Qatar Biomedical Research Institute, and by the Science Program at Texas A&M University at Qatar.

11:42AM B3.00007 Efficient Stochastic Model Simulation by Using Zassenhaus Formula Approximation and Kronecker Product Analysis. MEHMET UMUT CAGLAR, RANADIP PAL, Texas Tech University — Biological systems are inherently stochastic such that they require the use of probabilistic models to understand and simulate their behaviors. However, stochastic models are extremely complex and computationally expensive which restricts their application to smaller order systems. Probabilistic modeling of larger systems can help to recognize the underlying mechanisms of complex diseases, including cancer. The fine-scale stochastic behavior of genetic regulatory networks is often modeled using stochastic master equations. The inherently high computational complexity of the stochastic master equation simulation presents a challenge in its application to biological system modeling even when the model parameters can be properly estimated. In this article, we present a new approach to stochastic model simulation based on Kronecker product analysis and approximation of Zassenhaus formula for matrix exponentials. Simulation results illustrate the comparative performance of our modeling approach to stochastic master equations with significantly lower computational complexity. We also provide a stochastic upper bound on the deviation of the steady state distribution of our model from the steady state distribution of the stochastic master equation.

11:54AM B3.00008 Bacterial Growth in Weak Magnetic Field. SAMINA MASOOD, Univ. of Houston Clear Lake — We study the effect of the weak magnetic field on the growth of bacteria. We found that the magnetic field has tremendous effects on the growth of bacteria. They follow the same growth curve however the increased growth rate led the growth curve follow through its path, quickly. We also notice that different magnetic fields affect differently on different types of bacteria.

1Texas Space Grant Consortium
10:30AM B4.00001 Searching For Dark Matter Portals Using B Meson Decays to Four Leptons¹, LANDON BANISTER, Southern Methodist University, BaBar Collaboration — Dark matter appears to make up most of the matter in the universe, but its composition is still not understood. However, “portals” between normal matter and dark matter have been proposed and they can be searched for using existing experiments. The purpose of my research is to use data collected by the BaBar Experiment using electron-positron collisions from the PEPII Collider to search for a rare connection between the standard model of particle physics and one of the many predicted dark matter models. This connection involves the decay from “normal” matter particles (B-mesons) into two intermediate “dark” particles, that then subsequent decay to lepton pairs, leading to the unique signature of a four-lepton final state. My research focused on selecting such decays and on understanding how well these decays can be understood using Monte Carlo simulation. If we observe these decays, it might help us understand the connection between normal and dark matter.

¹ I would like to thank the BaBar Collaboration, the PEP-II accelerator team, and especially the Hamilton Family for their generous support of my undergraduate research through the Hamilton Scholar Program.

11:00AM B4.00002 Search for Supersymmetry in the Coannihilation Region of mSUGRA at the LHC, CHRISTOPHER DAVIS, DAVID TOBACK, TERUKI KAMON, WILL FLANAGAN, Texas A&M University, CMS Collaboration — In Experimental High Energy Physics, searches for new particles involve being able to determine how well the detector can pass events before any analysis cuts are used for optimization. We have studied the HLT_PFMET150 trigger at the CMS detector at the LHC for use in a search for supersymmetry in the coannihilation region of mSUGRA. We are able to find the efficiency as a function of MHT and also what effect the number of vertices in an event has on the efficiency.

11:12AM B4.00003 Electric susceptibility for strongly magnetized QED at finite temperature and density, PAUL SPRINGSTEEN, EFRAIN FERRER, VIVIAN INCERA, ANGEL SANCHEZ, Department of Physics, University of Texas at El Paso — The electric linear-response of strongly magnetized electron-positron plasmas at finite temperature and density is investigated. Calculating the one-loop polarization operator in that strongly magnetized medium, we find the photon effective Debye mass, and from there we find how the medium electric susceptibility changes with temperature and density. We are reporting a singular behavior for the electric susceptibility for values of the chemical potential close to the electron mass. Highly magnetized systems at finite temperature and density are commonly found in astrophysics applications and in heavy-ion collision experiments.

11:24AM B4.00004 Low Mass WIMP Search Using High Pressure Xenon Gas, CLEMENT SOFKA, Texas A&M University — Several groups around the globe employ unique detector technologies in the direct search for dark matter weakly interacting massive particles (WIMPs). One of the leading technologies uses scintillation and ionization signals produced when WIMPs scatter off xenon nuclei. Recent compelling results hint at the possibility of a less massive WIMP (7 – 10 GeV/c²), than was previously thought. A plan will be presented for a low mass WIMP search using high pressure xenon, and possibly neon gas. The design, calibration, and expected results will be discussed.

11:36AM B4.00005 Measurement of Angular Distributions for Z/gamma* plus Jet Events in pp Collisions at √s = 7 TeV, KITTIKUL KOVIANGGOON, graduate student, SUNG-WON LEE, NURAL AKCHURIN, Professor, CMS Collaboration — We present the angular distributions in events containing a Z boson and a jet. The data samples correspond to ~5/fb of proton-proton collisions at √s = 7 TeV, collected by the CMS detector in the year of 2011. The jet transverse momentum must be greater than 30 GeV/c and the absolute jet pseudorapidity must be less than 2.4. We compare our measurements with a next-to-leading-order perturbative QCD calculation and two generator programs that combine tree-level matrix element calculations with parton showers.

11:48AM B4.00006 Hierarchies of SUSY Splittings, WALTER TANGARIFE GARCIA, WILLY FISCHLER, The University of Texas at Austin — We explore how to generate hierarchies in the splittings between superpartners. Some of the consequences are the existence of invisible components of dark matter, new inflation candidates, invisible monopoles and a number of invisible particles that might dominate during various eras, in particular between BBN and recombination and decay subsequently. Finally, we generalize those hierarchies to a string theory construction.

Friday, October 26, 2012 10:30AM - 12:00PM – Session B4 Particle, Nuclear, and Accelerator Physics: 2012 Undergraduate Robert S. Hyer Award Recipient & Contributed Papers Holiday Inn Towers Tumbleweed - Chair: Richard Wigmans, Texas Tech University

10:30AM B5.00001 The Gravitational Potential, Gravitational Acceleration, and Vertical Gravity Gradient of a Rising Thermal Mantle Plume: A Numerical Experiment, JUAN H. HINOJOSA, Texas A&M International University — Thermal convection in the mantles of the terrestrial planets is an important mode of heat transfer from the planet’s interior. Gravitational instabilities originating at hot, thermal boundary layers at depth, either at the core-mantle boundary or at an interface between the upper mantle and lower mantle, are responsible for a type of convection that gives rise to thermal mantle plumes. Since the inferred horizontal dimensions of mantle plumes as a whole are small compared with their vertical dimensions, it is difficult to observe mantle plumes directly. To better understand the mantle plume’s gravitational expression at the surface, the gravitational potential, gravitational acceleration, and vertical gravity gradient of a rising mantle plume are calculated in a series of numerical experiments. An axially symmetric mantle plume is modeled using a composite of spheres and/or disks of various depths, radii, thicknesses, and density contrasts. The density contrast used in the numerical experiments is due to the temperature difference between an isothermal plume and the local geotherm for plumes at depths greater than the depth of pressure-release melt, and is due to the melt density contrast elsewhere. The resulting gravitational quantities for the spheres are obtained with straightforward, analytical expressions, but those for the disks are obtained by numerical integration. The results of the numerical experiments will be presented.
alternate mechanisms for plasma relaxation need to be considered for plasma states new marginal stability. It is also possible that these chirping space structures take an alternate route, and move to regions of phase space that are lower energy states of the energetic particle distribution. Chirping to the formation of phase space structures in the form of holes and clumps. Normally a saturated mode, in the presence of background excite background waves that the plasma can support such as shear Alfvén waves. The explanation for this phenomenon attributes the frequency accelerated quantum particles. In this talk, we present several examples based on this formalism, including the time evolution of a relativistic of a single spin-zero quantum particle. Being a generally covariant theory, this formalism introduces a new notion of global simultaneity for a recent paper [Bill Poirier, arXiv:1208.6260 [quant-ph]], a trajectory-based formalism has been constructed to study the relativistic dynamics of a single spin-zero quantum particle. Being a generally covariant theory, this formalism introduces a new notion of global simultaneity for accelerated quantum particles. In this talk, we present several examples based on this formalism, including the time evolution of a relativistic Gaussian wavepacket. Energy-momentum conservation relations may also be discussed.

Overview of Spontaneous Frequency Chirping in Confined Plasmas, HERBERT BERK, Institute for fusion studies, University of Texas at Austin — Spontaneous rapid frequency chirping is now a commonly observed phenomenon in plasmas with an energetic particle component. These particles typically induce so called weak instabilities, where they excite background waves that the plasma can support such as shear Alfvén waves. The explanation for this phenomenon attributes the frequency chirping to the formation of phase space structures in the form of holes and clumps. Normally a saturated mode, in the presence of background dissipation, would be expected decay after saturation as the background plasma absorbs the energy of the excited wave. However the phase space structures take an alternate route, and move to regions of phase space that are lower energy states of the energetic particle distribution. Through the wave–resonant particle interaction, this movement is locked to the frequency observed by the wave. This phenomenon implies that alternate mechanisms for plasma relaxation need to be considered for plasma states new marginal stability. It is also possible that these chirping mechanisms can be used to advantage to externally control states of plasma.

Noether’s Theorem and the Work-Energy Theorem for a Particle in an Electromagnetic Field, DONALD KOBE, University of North Texas — Noether’s theorem is based on two fundamental principles. The first is the extremum of the action and the second is the invariance of the action under infinitesimal continuous transformations. The first gives Hamilton’s principle of least action that results in the Euler-Lagrange equation. The second gives the Rund-Trautman identity for the generators of infinitesimal transformations. We apply these to a charged particle in an external electromagnetic field. The Euler-Lagrange equation gives the equation of motion. A solution of the Rund-Trautman identity for the generators is obtained by solving the generalized Killing equations. When the Euler-Lagrange equation and the Rund-Trautman identity are combined we obtain Noether’s theorem for a conserved quantity. Using the equation of motion and the generators of infinitesimal transformations for a charged particle in an external electromagnetic field, we obtain the work-energy theorem. Even though this theorem can be obtained directly from the equation of motion, this problem is a good example of using Noether’s theorem that is necessary for more complicated situations.
10:30AM B8.00001 Thermal conductivity of Si nanowires: the impact of the surface, BYUNGKUN KANG, Texas Tech University, STEFAN ESTREICHER TEAM — The thermal conductivity of Si nanowires is calculated from first principles at T=125K using the theoretical “laser-flash” method. The nanowires are represented by the 1-D periodic supercells Si_{200}X_{12} and Si_{296}X_{12}, where X is H or D or an OH group. The present focus is on the impact of the surface of the nanowire on the thermal conductivity. The bulk phonons cannot “scatter” off the surface of the nanowire as this would require exciting modes with frequencies higher than bulk-mode frequencies at any probability even for low surface roughness. Instead, the high-frequency wag modes of the H surface atoms couple resonantly to each other, leading to rapid decay into linear combinations of bulk modes. Thus, the surface reduces the thermal conductivity of the nanowire because heat propagates at the surface much more slowly than in the bulk.

10:42AM B8.00002 Isotope effect in the vibrational lifetime of the CH\textsubscript{3} defect in Si, MICHAEL GIBBONS, STEFAN ESTREICHER, Texas Tech University, MICHAELA STAVOLA, Lehigh University — The CH\textsubscript{3} defect in Si has two metastable configurations with H bound to bond-centered (BC) or antibonding (AB) sites of Si and C. Si-H\textsubscript{BC}...C-H\textsubscript{AB} or H\textsubscript{AB}-Si...H\textsubscript{BC}-C. The IR absorption signature of this defect should consist of four sharp lines associated with the two Si-H and two C-H stretch modes, respectively. In fact, only three have been seen by FTIR, and the fourth, very broad, line has only recently been reported by the highly sensitive multiple-interference-reflection FTIR. Further, the “missing” mode produces a very sharp line only for the deuterium substitution Si-H\textsubscript{BC}...C-D\textsubscript{AB}. Our calculations show that this is due to the isotope-dependence of the vibrational lifetime of this mode. The C-H mode decays very quickly into two phonons and the very short lifetime causes the IR line to be extremely broad. On the other hand, the C-D mode has a much longer lifetime and decays into at least three phonons, resulting in a much sharper IR line. We will report the calculations of these vibrational lifetimes.

10:54AM B8.00003 Thermodynamic theory and specific heat of metallic micro and nanowires, DENIS MYASISHCHEV, JOSEF CEPAK, MARK HOLTZ, JORDAN BERG, Texas Tech University — Thermal conductivity drops dramatically at the nanoscale. Effective power dissipation is crucial for solid state devices, but thermal conductivity decreasing with size complicates miniaturization efforts. There are few direct measurements of thermal conductivity of nanoscale structures. We report fabrication and characterization of nickel nanowires. The data analysis used by previous authors neglects time-varying and higher-order terms in a series expansion of the one-dimensional transient heat equation. This approximation is inaccurate at “high” currents, restricting the attainable signal-to-noise ratio. We remove this source of estimation error with a transient electrothermal finite element model. The approach has been validated with nickel nanowires on a 25\textmu m diameter platinum wire over a broad temperature range and extension to the nickel nanowires will be discussed.

11:06AM B8.00004 Majorana Fermions Under Stress, LI MAO, MING GONG, Department of Physics, the University of Texas at Dallas, Richardson, TX, 75080 USA, SUMANTA TEWARI, Department of Physics and Astronomy, Clemson University, Clemson, SC, 29634 USA, CHUANWEI ZHANG, Department of Physics, the University of Texas at Dallas, Richardson, TX, 75080 USA — Spin-orbit coupled semiconductor nanowires with Zeeman splitting in proximity contact with bulk s-wave superconductivity have recently been proposed as a promising platform for realizing Majorana fermions. However, in this setup the chemical potential of the nanowire is generally pinned by the Fermi surface of the superconductor. This makes the tuning of the chemical potential by external electrical gates, a crucial requirement for unambiguous detection of Majorana fermions, very challenging in experiments. Here we show that tunable topological superconducting regime supporting Majorana fermions can be realized in semiconductor nanowires using uniaxial stress. For n-type nanowires the uniaxial stress tunes the effective chemical potential, while for p-type systems the effective pairing may also be modified by stress, thus significantly enhancing the topological minigap. We show that the required stress, of the order of 0.1\%, is within current experimental reach using conventional piezo crystals.

11:18AM B8.00005 Optical limiting by absorption bleaching in carbon nanotube devices: comparison of field induced and electrochemically induced charge injection, W. JOSHUA KENNEDY, NASA Johnson Space Center, Z. VALY VARDENY, University of Utah — We studied direct charge injection in a heterogeneous film of single-wall carbon nanotubes using the technique of charge-induced absorption. The injectors were found to strongly enhance the interactions of the nanotubes with free carriers. These effects parallel those of the electrochemical doping in the same samples. Furthermore, we interpret the bleaching bias in the electroabsorption (a \chi\textsubscript{3} process) in isolated SWNT as being due to injected charges, which has implications for a variety of SWNT based optoelectronic devices, including nanoscale optoelectronic switches.

11:30AM B8.00006 Many-body Landau-Zener Transition in Cold Atom Double Well Optical Lattices, YINYIN QIAN, MING GONG, CHUANWEI ZHANG, The University of Texas at Dallas — Ultra-cold atoms in optical lattices provide an ideal platform for exploring many-body physics of a large system arising from the coupling among a small number of identical systems whose few-body dynamics are exactly solvable. Using Landau-Zener (LZ) transition of bosonic atoms in double well optical lattices as an experimentally realizable model, we investigate such few to many body route by exploring the relation and difference between the small few-body (in one double well) and the large many-body (in double well lattice) non-equilibrium dynamics of cold atoms in optical lattices. We find the many-body coupling between double wells greatly enhances the LZ transition probability, while keeping the main features of the few-body dynamics. Various experimental signatures of the many-body LZ transition, including atom density, momentum distribution, and density-density correlation, are obtained.

11:42AM B8.00007 Single-Photon X-ray Detector Using AlGaN/GaN Heterostructure, IMAN REZANEZHAD GATABI, Electrical Engineering Department, Texas A&M University-College Station, TX, JOEL SANDER, RUPAK MAHAPATRA, Physics and Astronomy Department, Texas A&M University, College Station, TX, HARLAN RUSTY HARRIS, Physics and Astronomy and Electrical Engineering Departments, Texas A&M University, College Station, TX, HARRIS INTEGRATED PHOTONICS AND ELECTRONICS LAB TEAM, MAHAPATRA RESEARCH GROUP TEAM — Rejection of external photons is critical in eliminating background signals for low background detectors including dark matter detectors. Experiments typically employ expensive shielding including ancient Pb. Herein we describe the design of a single-photon detector in the MeV range using an AlGaN/GaN heterostructure. Thin, electrically isolated GaN is used as the bulk material for electron-hole pair generation, and a device is formed with the 2D electron gas (2DEG) at AlGaN/GaN interface due to GaN spontaneous polarization. Numerical simulations of the distribution of carriers with MeV excitation are used to estimate device response of the structure. Application to photon veto in dark matter and double beta decay research is discussed, and an integration scheme is outlined that will allow nearly complete photon veto of cosmic EM background.

\textsuperscript{1}We thank the National Science Foundation (Grant No. 0618242) for funding the x-ray Photoelectron Spectrometer. Financial support from the NSF Grant Nos. #1028910 and #0901699 is gratefully acknowledged.
11:54AM B8.00008 Using phonon imaging to measure elastic constants in crystals of low symmetry, ADAM SIMPSON, ELIZABETH CARLISLE, TIM HEAD, Abilene Christian University — We attempt to use spatial data from phonon-imaging to identify elastic constants of materials. The current analysis compares continuum limit Monte-Carlo simulations of phonon images to data and attempts to use a minimization process to find the appropriate elastic constants for a material. We are currently working on a proof of concept for Si which has 3 independent elastic constants, but hope to scale up the process to be able to identify the 7 independent elastic constants in CaWO4.

12:06PM B8.00009 QMSA Measurements of III-V Heterostructures on Silicon, THIESS CUNNINGHAM, RAVI DROOPAD, Texas State University, RICHARD HILL, MAN HOI WONG, SEMATECH, TEXAS STATE UNIVERSITY COLLABORATION, SEMATECH COLLABORATION — There is widespread consensus that high mobility III-V channel materials will enable increased performance and reduced power consumption at scaled geometries. The industry is currently targeting the 11 nm technology node for their introduction. A most significant challenges is the heterointegration of III-V channel materials on Si substrates. Carrier transport of MBE grown InGaAs/InAlAs HEMTs on InP and Si substrates using Quantitative Mobility Spectrum Analysis (QMSA). Measurements taken determine effect of epitaxial defects on channel transport and buffer leakage. The continued scaling of Si CMOS devices has reached a point of, alternative solutions to conventional MOSFETs are needed. A solution considered is use of III-V compound semiconductors as channel materials. However, requirements are that materials need be epitaxially integrated to silicon, be able to withstand the thermal budget in various CMOS processing modules. This presentation, will present the electrical characterization of MBE grown III-V InGaAs/InAlAs heterostructures on silicon. Transport measurements at various temperatures ranging from 10k-room temperature in magnetic fields from 0-10T. From these measurements, QMSA of the data is carried out to the densities and mobilities of the conducting and buffer layers.

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10:30AM - 10:30AM — Session B9 Posters I: Materials Nanoscience, Biophysics, Chemical Physics (10:30am - 12:15pm) Holiday Inn Towers Atrium - Chair: Charles W. Myles, Texas Tech University

B9.00001 Towards a Notion of Symmetry for Topological Phases, MATTHEW TITSWORTH, TOBIAS HAGGE, University of Texas, Dallas — Landau’s theory of group symmetry breaking has been hugely successful in the description of classical and quantum phase transitions. However, recently discovered and proposed topological phases lie outside of the Landau paradigm. The primary physical example of these are fractional quantum Hall effect (FQHE) liquids. Topological phases possess no such broken symmetry and cannot be characterized by a symmetry gap. The primary field theories for topological phases are topological quantum field theories (specifically (2+1)-TQFTs) with a proposed microscopic mechanism in string-net condensation. They possess a number of unique features such as ground state degeneracy and non-trivial quasi-particle exchange statistics. We investigate the mathematical tools used to characterize (2+1) TQFTs/FQHE liquids for the purpose of trying to determine appropriate “symmetry objects” for such systems and possible mechanisms for describing their phase changes.

B9.00002 Cyclic Transition Processes for Muonium in SiGe Alloys, GANGA JAYARATHNA, LAWRENCE HUDY, PÅTRIK MENGYAN, BRITTANY BAKER, Texas Tech University, Lubbock, TX, BRENT CARROLL, Arkansas State University, Jonesboro, AK, YASAR CELEBI, Istanbul University, Istanbul, Turkey, ROGER LICHTI, Texas Tech University, Lubbock, TX — Muonium equivalent of the donor and acceptor levels of H in Si1−xGex alloy system based primarily on the ionization energies obtained for MuD and acceptor centers. We are currently undertaking longitudinal depolarization measurements in SiGe alloys in an attempt to determine acceptor energy over the full alloy range, to determine the position of band-resonant T-site acceptor level for large x, and to examine other cyclic transition processes. Critical energies associated with the cycle limiting transitions have been extracted from temperature dependence of the amplitudes associated with various components of the longitudinal signal. We are attempting to fit temperature and field dependences of relaxation rates to models derived from tentative cycle assignments. These results will provide a check of the previous assignments and on the transition energy determinations and should access a few energies that have not previously been determined. Progress to date in modeling the temperature dependence of relaxation rates will be discussed.

B9.00003 Probing Local features in Dilute Magnetic Semiconducting ZnGeP2:Mn via MuSR, P.W. MENGYAN, R.L. LICHTI, B.B. BAKER, Texas Tech University, Physics, Y.G. CELEBI, E. CATEK, Istanbul University, Beyazıt 3449 Istanbul, Turkey, K. T. ZAWILSKI, P.G. SCHUNEMANN, BAE Systems, Advanced Systems and Technology, Nashua, NH — The conventional semiconducting properties and the discovery of room temperature ferromagnetism in weakly Mn doped II-IV-V2 chalcoprite semiconductors make these materials prime candidates for prospective use in the field of spin-electronics. The mechanism responsible for connecting the local magnetic features to the bulk magnetic properties is not yet understood in these materials. Muon Spin Research (MuSR) utilizes the unique sensitivity of 100% spin polarized and positively charged muons to probe local magnetic and electronic environment. We have initiated a MuSR investigation on dilute magnetic semiconducting II-IV-V2 specifically focused on the, yet to be understood, magnetic features. This contribution presents results of our first set of MuSR measurements on four different ZnGeP2:Mn, each with a different Mn content. We have detected at least three distinct spin fluctuation regimes; antiferromagnetic, ferromagnetic and one that is possibly related to spin polaron formation. Considerable amounts of modeling and measurements are required in order to develop a more complete characterization and assignment for each of these features. These are promising first steps in the larger-scale project of developing a more complete understanding of the magnetic features in DMS systems.

1Supported by DOE.
B9.00004 New insights into the surface structure of Pt-Pd core-shell nanoparticles as revealed by Cs-corrected STEM
- SUBARNA KHANAL, GILBERTO CASILLAS, J. JESUS VELAZQUEZ-SALAZAR, ARTURO PONCE, MIGUEL JOSE YACAMAN, Department of Physics and Astronomy, University of Texas at San Antonio — Bimetallic nanoparticles of Pt-Pd core-shell structures have been found to possess significant applications in fuel cells, hydrogen storage, catalysis, etc. However, the cost of Pt makes it unpractical to use in big quantities; therefore, one of the big challenges is to very small catalysts with only a few layers of the active metal in the shell in order to maximize the efficiency in their use. In this work the modified polyol method was used to synthesize Pt-Pd core-shell nanoparticles in the size range of 20 nm and characterized them by Cs-corrected scanning transmission electron microscopy. This technique allowed us to probe the structure at the atomic level of these nanoparticles revealing new structural information. We determined the structure of the three main polyhedral morphologies obtained in the synthesis: octahedral, decahedral and triangular plates. These final shapes of the core-shell structures were determined by the seed morphology. In addition the STEM energy dispersive X-ray spectroscopy (EDS) chemical analysis can be better identified the chemical composition of the nanocrystals. The overgrowth of the thin Pd shells on the Pt cores due to the epitaxial growth modes was observed. In this work, we have been able to observed Shockley partial dislocations, stacking faults, and adatoms at the surfaces of the nanoparticles.

1The authors would like to acknowledge to the NSF for support with grants DMR-1103730 and NSF PFREM Grant # DMR 0934218.

B9.00005 Effective Nonradiative Energy Transfer Between Nanocrystal Bilayers Enhanced by 1,6-Hexanediol Linkers
- MICHAEL NIMMO, ERICK GONZALEZ, NIELS RAMAY, OLIVER SEITZ, YVES CHABAL, ANTON MALKO, University of Texas at Dallas — Nanostructured materials attract great interest as candidates for producing new, practical photonic electronic devices. Many current devices are based on charge-transfer in which primary photoexcitations are separated into an electron and a hole on different sides of the interface. Poor interface quality and carrier transport are issues that result in a lower conversion efficiencies than in inorganic crystalline devices. An alternative is given by non-radiative energy transfer (NRET) based hybrid nanostructures, which combine strongly absorbing components such as nanocrystal quantum dots (NQDs) and high-mobility semiconductor layers. In this work, we compared the effectiveness of 1,6-hexanediol vs. 1,6-hexanediol to link multilayer NQD structures. Steady state photoluminescence (PL) measurements showed that using 1,6-hexanediol consistently resulted in higher PL counts and passivation of the NQDs. Furthermore, we studied bilayer structures of different size NQD layers (565NQDs on 605NQDs) linked with 1,6-hexanediol. We performed time-resolved and steady-state PL measurements to quantify the NRET rates between the 565NQD layer and the 605NQD layer. NRET rates were consistently 91%. Hence, we foresee the utilization of bilayer NQD structures linked with 1,6-hexanediol in energy transfer-based systems.

B9.00006 Non-Radiative Energy Transfer Into Nanometer-Scale Thin Semiconductor Films
- JOSEPH GORDON, YURI GARTSTEIN, University of Texas at Dallas — Non-radiative energy transfer (NRET) has gained a lot of attention recently due to its possible utility in new generations of light-emitting and photovoltaic devices. In this process, a “donor” species in an excited state transfers its excitation energy resonantly to an “acceptor” species. A classical realization of NRET is Förster ET between two point-like species. Our interest is in ET between a small donor and an ultrathin acceptor layer. The layers can be realized as planar ensembles of molecules or QDs or as a thin crystalline semiconductor slab. We use two complementary approaches to study the effects of dielectric polarization in thin layers on ET rates: (1) The classical macroscopic electrodynamics treating the acceptor layer as a continuum of certain dielectric permittivity; (2) A direct modeling utilizing planar acceptor lattices, each of the acceptors treated as a polarizable point dipole. Comparison of the results allows us to establish salient qualitative features as well as to clarify the role of local-field factors. Of particular interest is our finding a broad region of the dielectric responses where ET into thinner films counter-intuitively turns out to be more efficient than ET into thicker films.

B9.00007 Characterization of Energetic Properties of Porous Silicon
- BLAKE MCCracken, Angelo State University — Porous silicon has recently been found to explode when under certain oxidation or nitration conditions. However, characterization of the velocity and pressure of these explosions is not been complete, as there are many kinds of porous silicon. We present a simple and inexpensive method to measure these properties using PVDF piezoelectric gauges. Here, the gauges are calibrated qualitatively against common firecrackers, similar to black cats. While the pressure measurements from our results are still being analyzed, the velocity of the shock wave produced by the explosion is faster than the speed of sound, about 430 m/s.

B9.00008 Dilution factor measurement setup for a vibrating steel string
- MOISES CASTILLO, TREvor GUSTON, CADE DANIEl, Department of Physics and Astronomy and Center for Gravitational Wave Astronomy, University of Texas at Brownsville, Brownsville, Texas 78520 USA; JOE AvILA, JUAN VAZQUEZ, Department of Engineering, University of Texas at Brownsville, Brownsville, Texas 78520 USA; GIANPIETRO CAGNOLI, Laboratoire des Matériaux Avancés, Université Claude Bernard Lyon 1, Campus de la DOUA, Villeurbanne Cedex 69622 France, MARIO DIAZ, Department of Physics and Astronomy and Center for Gravitational Wave Astronomy, University of Texas at Brownsville, Brownsville, Texas 78520 USA — Measurements of mechanical losses have been done in the past in configurations parallel and perpendicular to the gravitational potential of earth with different sample shapes. Gravity will modify the quality factor of resonances when the restoring force depends on it, like in a pendulum. The proposed configuration used for this work involves a steel string under tension. The restoring force will be due to the tension rather than gravity. The goal is to quantify the relation between the tension of a steel string and its quality factor for varied resonant modes.

1Support for this work came from Center for Gravitational Wave Astronomy (CGWA) and grants NASA # NNX09AV06A and NSF # HRD0734800.

B9.00009 Properties of the Oxidized Cu(110) Surface: The DFT study
- ANTOINE OLENGA, N.G. FAZLEEw, University of Texas at Arlington — The study of adsorption of oxygen on transition metal surfaces is important for the understanding of oxidation, heterogeneous catalysis, and metal corrosion. In this work we have studied from first principles the changes of electronic properties of the Cu(110) surface due to oxygen adsorption. Especially, we have focused on studies of changes in the work function, electronic density, interlayer spacing, density of states and band structure with oxygen coverage. Calculations of electronic properties from first principles have been also performed for the (110) and surface of CuO to use for comparison. The first-principles calculations in this work have been performed on the basis of the Density Functional Theory and using DMOl3 code. The obtained theoretical results have been compared with available experimental data.
B9.00010 Properties of Carbon Nanotubes†, SAMINA MASOOD, DANIEL BULLMORE, MICHAEL DURAN, MICHAEL JACOBS, University of Houston Clear Lake — Different synthesizing methods are used to create various nanostructures of carbon; we are mainly interested in single and multi-wall carbon nanotubes, (SWCNTs) and (MWCNTs) respectively. The properties of these tubes are related to their synthetic methods, chirality, and diameter. The extremely sturdy structure of CNTs, with their distinct thermal and electromagnetic properties, suggests a tremendous use of these tubes in electronics and medicines. Here, we analyze various physical properties of SWCNTs with a special emphasis on electromagnetic and chemical properties. By examining their electrical properties, we demonstrate the viability of discrete CNT based components. After considering the advantages of using CNTs over microstructures, we make a case for the advancement and development of nanostructures based electronics. As for current CNT applications, it’s hard to overlook their use and functionality in the development of cancer treatment. Whether the tubes are involved in chemotherapeutic drug delivery, molecular imaging and targeting, or photodynamic therapy, we show that the remarkable properties of SWCNTs can be used in advantageous ways by many different industries.

†Texas Space Grant Consortium

B9.00011 Study of plasmonic crystal to metamaterial transition in dielectric doped two-dimensional periodic structures, SHIVKUMAR GOIRISHETTY, CHARLES REGAN, LUIS GRAVE DE PERALTA, AYRTON BERNUSSI, Nano Tech Center, Texas Tech University — We investigated experimentally the transition from plasmonic crystal to metamaterial in dielectric-loaded plasmonic two-dimensional periodic structures with different lattice periods and lattice symmetries. The transition occurs due to changes in the effective refractive index of the plasmonic crystals when the period and/or the size of the patterned features are varied. The effective refractive index of the plasmonic structure can be further modified when an object (i.e. a virus, a bead, a cell, etc.) is placed on the top of the sample, thus altering the transition. This can be prospectively used for nanosensing applications. The samples investigated here were fabricated using a combination of electron-beam lithography and liftoff techniques and consisted of a glass substrate, a thin film of gold, and periodic arrays of air holes defined on PMMA doped with Rhodamine 6G. The plasmonic crystal to a metamaterial transition region was investigated using the leakage radiation microscopy technique. We determined that the transition occurs for lattice periods 262 nm and 310 nm for samples with square and hexagonal lattice symmetries, respectively.

B9.00012 Effect of Diameter on Radiation Emitted by Carbon Nanotubes in Microwave Fields, SARAH FERGUSON, DANIEL GONZALES, BRANDON CAVNESS, NIEMAN MCGARA, SCOTT WILLIAMS, Angelo State University — Carbon Nanotubes have been observed to emit ultraviolet, visible, and infrared radiation when placed in microwave fields. We have irradiated nanotubes of different diameters with 2.45 GHz microwaves and studied the spectra of the emitted radiation. We have also compared the spectra after several irradiation and cooling cycles in order to try and determine the mechanisms responsible for observed phenomena.

B9.00013 Study of Surface Plasmon Polariton propagation in Plasmonic Waveguides, WILLIS AGUTU, CHARLES REGAN, AYRTON BERNUSSI, LUIS GRAVE-DE-PERALTA, Texas Tech University, PHYSICS DEPARTMENT, TEXAS TECH UNIVERSITY COLLABORATION, NANO TECH CENTER, TEXAS TECH UNIVERSITY COLLABORATION — Using surface plasmon polariton (SPP) tomography techniques, we study the propagation of SPPs in dielectric-loaded plasmonic waveguides. Surface emission and Fourier plane tomography images were used to characterize SPP propagation and losses in straight and curved, single and multimode waveguides. This study shows the imaging and characterization capabilities of SPP tomography.

B9.00014 Manipulating the Crystal Growth of Organic Energetic Materials on Substrates, XIN ZHANG, GENGXIN ZHANG, BRANDON WEEKS, Texas Tech University — Organic energetic materials (OMEs) have been attracted a lot of attention due to its wide application in military weapon. One of the most compelling researches is manipulating the crystal structure of OMEs due to their performances, such as ignition and burning rate, which depend strongly on the crystalline structure. The crystalline structure of OMEs on substrates has strong dependence on the experimental parameters, such as the deposition rate and external factors. This report demonstrates a new technique for manipulating the crystal growth of OMEs on substrates by micro-contact printing. The methodology depends on coating a polymer stamp with a surfactant, which has a strong affinity for the OMEs deposited on the substrate. The coated stamp selectively removes OMEs in contact areas when the stamp was lifted. And then the OMEs that were left on the substrates grew to the crystals. By careful choice facile film preparation method and optimal stamp pattern, this technique provides a new methodology for fabricating OMEs crystals from hexagon single crystals, dendrite crystals to micro-rod crystals and manipulating the size and distribution of these crystals.

B9.00015 Properties and Applications of Carbon Nanotubes†, DANIEL BULLMORE, MICHAEL DURAN, MICHAEL JACOBS, SAMINA MASOOD, University of Houston Clear Lake — Different synthesizing methods are used to create various nanostructures of carbon; we are mainly interested in single and multi-wall carbon nanotubes, (SWCNTs) and (MWCNTs) respectively. The properties of these tubes are related to their synthetic methods, chirality, and diameter. The extremely sturdy structure of CNTs, with their distinct thermal and electromagnetic properties, suggests a tremendous use of these tubes in electronics and medicines. Here, we analyze various physical properties of SWCNTs with a special emphasis on electromagnetic and chemical properties. By examining their electrical properties, we demonstrate the viability of discrete CNT based components. After considering the advantages of using CNTs over microstructures, we make a case for the advancement and development of nanostructures based electronics. As for current CNT applications, its hard to overlook their use and functionality in the development of cancer treatment. Whether the tubes are involved in chemotherapeutic drug delivery, molecular imaging and targeting, or photodynamic therapy, we show that the remarkable properties of SWCNTs can be used in advantageous ways by many different industries.

†Texas Space Grant Consortium
The excitation wavelength (750-850 nm), excitation power, and size of the NPs. These results and their potential applications will be discussed.

In this work, we have utilized femtosecond laser based two-photon excitation to study the emission of visible light (∼530 nm) as functions of the excitation wavelength (750-850 nm), excitation power, and size of the NPs. These results and their potential applications will be discussed.

The authors acknowledge support from National Science Foundation award ECCS 1028791 and the Norman Hackerman Advanced research Program CNo 003644-0042-2009.

B9.00017 Two photon excited fluorescence from diamond nanoparticles , ANKIT SINGH, MATHIAS AJAEROH, SAMAR MOHANTY, SURESH SHARMA, University of Texas at Arlington — The possibility of two photon excited fluorescence by diamond nanoparticles is an interesting nonlinear phenomenon. We have grown 20-100 nm diamond nanoparticles by using chemical vapor deposition (CVD) and characterized their properties by using complementary techniques of AFM, SEM, and Raman spectroscopy. In this work, we have utilized femtosecond laser based two-photon excitation to study the emission of visible light (∼530 nm) as functions of the excitation wavelength (750-850 nm), excitation power, and size of the NPs. These results and their potential applications will be discussed.

The authors would like to acknowledge to the NSF for support with grants DMR-1103730, “Alloys at the Nanoscale: The Case of Nanoparticles Second Phase and PREM”: NSF PREM Grant # DMR 0934218; “Oxide and Metal Nanoparticles.”

B9.00018 Study of growth mechanism and atomic structure of Au-Pd core-shell nanocube by Cs-corrected scanning transmission electron microscopy

B9.00019 Analysis of Crystalline Structure of Synthetic Opals Based on Their AFM Scans

B9.00020 Self-Assembled Nano-energetic Gas Generators based on Bi$_2$O$_3$
B9.00021 Modeling of oxidation of aluminum nanoparticles by using Cabrera Mott Model, ZAMART RAMAZANOVA, MAXIM ZYSKIN, KAREN MARTIROSYAN, Department of Physics and Astronomy, University of Texas at Brownsville — Our research focuses on modeling new Nanoenergetic Gas-Generator (NGG) formulations that rapidly release a large amount of gaseous products and generates shock and pressure waves. Nanoenergetic thermite reagents include mixtures of Al and metal oxides such as bismuth trioxide and iodine pentoxide. The research problem is considered a spherically symmetric case and used the Cabrera Mott oxidation model to describe the kinetics of oxide growth on spherical Al nanoparticles for evaluating reaction time which a process of the reaction with oxidizer happens on the outer part of oxide layer of aluminum ions are getting in contact with an oxidizing agent and react. We assumed that a ball of Al of radius 20 to 50 nm is covered by a thin oxide layer 2-4 nm and is surrounded by abundant amount of oxygen stored by oxidizers. The ball is rapidly heated up to ignition temperature to initiate self-sustaining oxidation reaction. As a result highly exothermic reaction is generated. In the oxide layer of excess concentrations of electrons and ions are dependent on the electric field potential with the corresponding of the Gibbs factors and that it conducts to the solution of a nonlinear Poisson equation for the electric field potential in a moving boundary domain. Motion of the boundary is determined by the gradient of a solution on the boundary. We investigated oxidation model numerically, using the COMSOL software utilizing finite element analysis. The computing results demonstrate that oxidation rate increases with the decreasing particle radius.

B9.00022 Investigation of using N and P Doped Graphene to Fabricate a Transistor, KYLE JOSEPH DRAKE, Stephen F. Austin State University — The atomic structure of graphene causes it to have a zero-energy band gap, where its valence and conduction bands meet at the Dirac point. By doping the graphene, a band gap can be created and it can then be used as a semiconductor similar to silicon. Nitrogen and Boron doped graphene will be used as n-type and p-type semiconductor materials to fabricate n-p-n transistors. The graphene will be doped with nitrogen to be the n-type semiconductor and boron to be the p-type semiconductor. This will be done by chemical vapor deposition (CVD) methods.

B9.00023 Kinetic Parameter Extraction of Square Wave Voltammograms from DNA-Modified Gold Electrodes, MARC MCWILLIAMS, CHRIS WOHLGAMUTH, JASON SLINKER, University of Texas at Dallas — The field of surface bound electrochemistry is important in a variety of applications specifically sensing. A fundamental understanding of the processes involved could help to improve detection limits, optimize rates of detection and direct changes in device design. Accurate extraction of electrochemical kinetic parameters such as the rate constant \( k \) and charge transfer coefficient \( \alpha \) from cyclic voltammograms can be challenging when confronted with large background currents and relatively weak signals. The commonly used technique of Laviron analysis is both time consuming and somewhat subjective. Square wave voltammetry (SWV) is therefore an ideal alternative method given that it maximizes signal while minimizing capacitive effects. In this experiment kinetic parameters of DNA-modified gold electrodes are obtained from SWV curves through background subtraction followed by nonlinear least squares fitting using a first order quasi-reversible surface process model. The fitting is accomplished using the Nelder-Mead simplex algorithm with standard parameters and a convergence condition of less than 0.0001%. General agreement with experimental data is shown with varying levels of confidence. Difficulties specific to this experiment are discussed as well as the possible benefits of utilizing the Bayesian statistical approach of nested sampling when confronted with multiple peaks of interest and the background source is well defined.

B9.00024 Temperature Dependent Kinetics DNA Charge Transport, CHRIS WOHLGAMUTH, MARC MCWILLIAMS, JASON SLINKER, The University of Texas at Dallas — Charge transport (CT) through DNA has been extensively studied, and yet the mechanism of this process is still not yet fully understood. Besides the benefits of understanding charge transport through this fundamental molecule, further understanding of this process will elucidate the biological implications of DNA CT and advance sensing technology. Therefore, we have investigated the temperature dependence of DNA CT by measuring the electrochemistry of DNA monolayers modified with a redox-active probe. By using multiplexed electrodes on silicon chips, we compare square wave voltammetry of distinct DNA sequences under identical experimental conditions. We vary the probe length within the well matched DNA duplex in order to investigate distance dependent kinetics. This length dependent study is a necessary step to understanding the dominant mechanism behind DNA CT. Using a model put forth by O’Dea and Osteryoung and applying a nonlinear least squares analysis we are able to determine the charge transfer rates \( k \), transfer coefficients \( \alpha \), and the total surface concentration \( I^* \) of the DNA monolayer. Arrhenius like behavior is observed for the multiple probe locations, and the results are viewed in light of and compared to the prominent charge transport mechanisms.

B9.00025 Biological Effects of Electromagnetic Fields on Cellular Growth, BEHESHTE EFTEKHARI, JAMES WILSON, SAMINA MAASOOD, University of Houston Clear Lake — The interaction of organisms with environmental magnetic fields at the cellular level is well documented, yet not fully understood. We review the existing experimental results to understand the physics behind the effects of ambient magnetic fields on the growth, metabolism, and proliferation of in vitro cell cultures. Emphasis is placed on identifying the underlying physical principles responsible for alterations to cell structure and behavior.

B9.00026 Multiscale Molecular Dynamics Simulations of Beta-Amyloid Interactions with Neurons, LIMING QIU, MARK VAUGHN, KELVIN CHENG, Texas Tech University — Early events of human beta-amyloid protein interactions with cholesterol-containing membranes are critical to understanding the pathogenesis of Alzheimer’s disease (AD) and to exploring new therapeutic interventions of AD. Atomicistic molecular dynamics (AMD) simulations have been extensively used to study the protein-lipid interaction at high atomic resolutions. However, traditional MD simulations are not efficient in sampling the phase space of complex lipid/protein systems with rugged free energy landscapes. Meanwhile, coarse-grained MD (CGD) simulations are efficient in the phase space sampling but suffered from low spatial resolutions and from the fact that the energy landscapes are not identical to those of the AMD. Here, a multiscale approach was employed to simulate the protein-lipid interactions of beta-amyloid upon its release from proteolysis residing in the neuronal membranes. We utilized a forward (AMD to CGD) and reverse (CGD-AMD) strategy to explore new transmembrane and surface protein configuration and evaluate the stabilization mechanisms by measuring the residue-specific protein-lipid or protein conformations. The detailed molecular interactions revealed in this multiscale MD approach will provide new insights into understanding the early molecular events leading to the pathogenesis of AD.
**B9.00027** Detection and Monitoring of Neurotransmitters - a Spectroscopic Analysis¹

FELICIA MANCIU, University of Texas at El Paso, El Paso, TX, KENDALL LEE, Mayo Clinic, Rochester, MN, WILLIAM DURRER, University of Texas at El Paso, El Paso, TX, KEVIN BENNET, Mayo Clinic, Rochester, MN — In this work we demonstrate the capability of confocal Raman mapping spectroscopy for simultaneously and locally detecting important compounds in neuroscience such as dopamine, serotonin, and adenosine. The Raman results show shifting of the characteristic vibrations of the compounds, observations consistent with previous spectroscopic studies. Although some vibrations are common in these neurotransmitters, Raman mapping was achieved by detecting non-overlapping characteristic spectral signatures of the compounds, as follows: for dopamine the vibration attributed to C=O stretching, for serotonin the indole ring stretching vibration, and for adenosine the adenine ring vibrations. Without damage, dyeing, or preferential sample preparation, confocal Raman mapping provided positive detection of each neurotransmitter, allowing association of the high-resolution spectra with specific micro-scale image regions. Such information is particularly important for complex, heterogeneous samples, where modification of the chemical or physical composition can influence the neurotransmission processes. We also report an estimated dopamine diffusion coefficient two orders of magnitude smaller than that calculated by the flow-injection method.

¹This work has been supported by a research agreement between Mayo Clinic and the University of Texas at El Paso.

**B9.00028** Influence of strain on the work functions of carbon nanotubes investigated by the first-principles method. WAN-SHENG SU, National Center for High-performance Computing, Tainan 744, Taiwan, HAN HU, Department of Physics, National Chung Cheng University, Chia-Yi 621, Taiwan — The responses of work functions to uniaxial strain for infinite-length single-walled armchair (AC) [(2,2) and (7,7)], and zigzag (ZZ) [(3,0) and (12,0)] carbon nanotubes (CNTs) are investigated based on density functional theory. It is found that as the strain is increased, the work function of ZZ (3,0) tubes decreases monotonically from 6.2 to 5.7 eV, whereas that of AC (2,2) tubes varies between 4.6 and 4.8 eV in a somewhat complicated manner. As for ZZ (12,0) and AC (7,7) tubes with large diameters, the work functions of ZZ (12,0) change almost linearly from 4.3 to 4.7 eV, whereas for AC (7,7) the work function values grow monotonically from 4.2 to 4.6 eV. Finally, the changes of the energy band give a qualitative understanding of how work function is affected by the uniaxial strain.

**B9.00029** Dynamical Properties of the Triangular Bouncer¹. MATTHEW HOLTFREICH, Northern Arizona University, BRUCE MILLER, Texas Christian University — This poster presents research on the dynamical properties of a Fermi bouncer with a triangular driving function using numerical simulation. A Fermi bouncer consists of a mass confined to move in one dimension that bounces on an oscillating floor. It will be shown that, for the elastic case of this bouncer, Fermi acceleration and stability islands exist. Periodic and quasiperiodic motion can be found with the exception of period 1 motion. The elastic version of the bouncer is a one parameter system. When the parameter's value is changed, the behavior of the system can change drastically. However, if the collisions of the system are inelastic, the system becomes a two parameter system that can change its behavior as either parameter is varied. Here, the new parameter arises from the velocity dependence of the coefficient of restitution. As in the elastic case, the inelastic case shows stable islands representing periodic and quasiperiodic motion. Not surprisingly, Fermi acceleration does not occur. An interesting observation is that, when the new parameter is varied, islands can be created or destroyed and complex patterns arise in the island structure.

¹This work was partially supported by an NSF REU grant (NSF-PHY 0851558) at Texas Christian University

**B9.00030** Molecular Dynamics Simulation of the Transport Properties of Molten Transuranic Salt Mixtures. AUSTIN BATY, PETER MACKENTIRE, AKHDIYOR SATTAROV, ELIZABETH SOOBY, Texas A&M University — The Accelerator Research Laboratory at Texas A&M is proposing a revolutionary design for accelerator-driven subcritical fission in molten salt (ADSMS), a system that destroys the transuranic elements in spent nuclear fuel. The transuranics are the most enduring hazard of nuclear fuel, since they contain high radiotoxicity and have half-lives of a thousand to a million years. The ADSMS core is fueled by a homogeneous chloride-based molten salt mixture containing the chlorides of the transuranics and NaCl. Knowledge of the density, heat capacity, thermal conductivity, etc. of the salt mixtures is needed to accurately model the complex ADSMS system. There is a lack of experimental data on the density and transport properties of such mixtures. Molecular dynamics simulations using polarizable ion potentials are used to determine the density and heat capacity of these melts as a function of temperature. Green-Kubo methods are employed to calculate the electrical conductivity, thermal conductivity, and viscosity of the salt using the outputs of the model. Results for pure molten salt systems are compared to experimental data when possible to validate the potentials used. Here we discuss potential salt systems, their neutronic behavior, and the calculated transport properties.

**Friday, October 26, 2012 12:30PM - 2:00PM**

Session C1 Lunch. TSAPS and TSTAAPT Business Meetings Holiday Inn Towers Petroleum

- Chair: Charles W. Myles, Texas Tech University

12:30PM C1.00001 Lunch —

1:00PM C1.00002 Business Meetings —

**Friday, October 26, 2012 2:00PM - 3:00PM**

Session D1 Plenary Session II: Biological and Medical Physics Holiday Inn Towers Petroleum

- Chair: Harry Swinney, University of Texas at Austin

2:00PM D1.00001 Physical Theory of the Immune System. MICHAEL DEEM, Rice University — I will discuss to theories of the immune system and describe a theory of the immune response to vaccines. I will illustrate this theory by application to design of the annual influenza vaccine. I will use this theory to explain limitations in the vaccine for dengue fever and to suggest a transport-inspired amelioration of these limitations.
2012 Alzheimer’s disease and the role of cholesterol in regulating lipid domains that mimic the nanoscopic raft and non-raft regions of the neural membrane. In this talk, I will summarize our current work on exploring early molecular events including protein insertion kinetics, protein unfolding, and protein-induced membrane disruption of \( \alpha \beta \) protein from atomic length and picosecond time resolutions, remains unclear. In our research, we have used atomistic molecular dynamics simulations to investigate the role of cholesterol in regulating lipid domains and protein interactions with neurons at the molecular level. Knowledge pertaining to the role of lipid molecules, particularly cholesterol, in modulating the single \( \alpha \beta \) protein has been associated with the pathogenesis of Alzheimer’s disease. Our results confirm that this effect can be largely explained by the enhanced post-meal excretion of glucagon-like peptide 1 (GLP-1), an incretin that increases insulin secretion from the pancreas, but also suggest that other mechanisms are likely to be involved, possibly including an additional insulin-independent pathway for glucose transport into cells.

1Supported by the Qatar Foundation through the Qatar Biomedical Research Institute and Texas A&M Qatar.

Friday, October 26, 2012 2:00PM - 3:30PM – Session D2 AAPT Workshop III: What is the Higgs Boson

2:00PM D2.00001 W3 - What IS a Higgs and where did it come from, EVELYN RESTIVO, Waxahachie Early College High School — A look at LHC, CERN, the HIGGS. Background information on what they were looking for and how they found it and what is means for you and your students.

Friday, October 26, 2012 2:00PM - 3:30PM – Session D3 AAPT Workshop IV: Science in Literature

2:00PM D3.00001 W4 - Science in Literature, KAREN JO MATSLER, University of Texas at Arlington — We are never too young or too old to enjoy a good piece of literature. Integrating science and literature results in the development of reading skills while helping students discover the wonders of science. This session will focus on learning activities for The Very Lonely Firefly and Why Mosquitoes Buzz in Your Ear. The lessons are designed for upper elementary but could be adapted for any grade level.

Friday, October 26, 2012 3:30PM - 5:28PM – Session E1 Invited & Contributed Papers: Chemical & Biological Physics

3:30PM E1.00001 DNA in Nanoscale Electronics, JASON SLINKER, The University of Texas at Dallas — DNA, the quintessential molecule of life, possesses a number of attractive properties for use in nanoscale circuits. Charge transport (CT) through DNA itself is of both fundamental and practical interest. Fundamentally, DNA has a unique configuration of \( \pi \)-stacked bases in a well ordered, double helical structure. Given its unparalleled importance to life processes and its arrangement of conjugated subunits, DNA has been a compelling target of conductivity studies. In addition, further understanding of DNA CT will elucidate the biological implications of this process and advance its use in sensing technologies. We have investigated the fundamentals of DNA CT by measuring the electrochemistry of DNA monolayers under biologically-relevant conditions. We have uncovered both fundamental kinetic parameters to distinguish between competing models of operation as well as the practical implications of DNA CT for sensing. Furthermore, we are leveraging our studies of DNA conductivity for the manufacture of nanoscale circuits. We are investigating the electrical properties and self-assembly of DNA nanowires containing artificial base pair surrogates, which can be prepared through low cost and high throughput automated DNA synthesis. This unique and economically viable approach will establish a new paradigm for the scalable manufacture of nanoscale semiconductor devices.

4:05PM E1.00002 Protein Unfolding and Alzheimer’s, KELVIN CHENG, Trinity University and Texas Tech University — Early interaction events of beta-amyloid (A/\( \beta \)) proteins with neurons have been associated with the pathogenesis of Alzheimer’s disease. Knowledge pertaining to the role of lipid molecules, particularly cholesterol, in modulating the single A/\( \beta \) interactions with neurons at the atomic length and picosecond time resolutions, remains unclear. In our research, we have used atomistic molecular dynamics simulations to explore early molecular events including protein insertion kinetics, protein unfolding, and protein-induced membrane disruption of A/\( \beta \) proteins in lipid domains that mimic the nanoscopic raft and non-raft regions of the neural membrane. In this talk, I will summarize our current work on investigating the role of cholesterol in regulating the A/\( \beta \) interaction events with membranes at the molecular level. I will also explain how our results can provide new insights into understanding the pathogenesis of Alzheimer’s disease associated with the A/\( \beta \) proteins.
4:40PM E1.00003 Causality, Symmetry, Brain, Evolution, DNA and a new Theory of Physics, SERGIO PISSANETZKY, Dep. of Physics, Texas A&M University, Retired — THEORY. Except for black holes, our world is causal. In Physics, causal sets formalize causality. The easiest way to explain the importance of causets is: all finite algorithms and computer programs are causets. Let S be a causet model of a dynamical system. S has a symmetry of the action: set P of all legal permutations of S. Hence all causets have conservation laws. Permutations in P represent trajectories in state space. But P is non-conservative. New Physics: an action functional F was observed. When F is minimized over P, conservative subset P* is obtained. In P*, conserved quantities emerge as group-theoretical block systems over S. Block systems are also causets, and iteration leads to a network of blocks. This is a new theory of Physics. PREDICTIONS. (1) Brain’s dendritic trees must be optimally short. Cuntz (June 2012) observed a 2/3 optimally short power law. (2) Causal hierarchies. Fuster(2005) observes identical hierarchies in cortex. DNA (Sept 2012) is described as hierarchical networks. (3) Action functional. Lerner (Aug 2012) proposed an action functional and minimum entropy on trajectories of dynamical processes. Friston (2003) proposed an energy functional. (4) Simple computer-brain experiments (Pissanetzky 2011a). REFERENCES: www.SciControls.com.

4:52PM E1.00004 DFT Studies on Charge Transfer States of a Multi-chromophoric Organic Heptad Antenna, LUIS BASURTO, University of Texas at El Paso — The electronic structure of the ground and the lowest charge transfer excited state of a molecular complex containing BODIPY dye, Zn-porphyrin, bisphenyl anthracene and fullerene are studied using density functional theory. The snowflaked shaped molecule behaves like an antenna capturing photons at different frequencies and transferring the energy to the porphyrin where electron transfer occurs from the porphyrin to the fullerene. We have calculated the energy of the lowest charge transfer state with a hole on proton and an electron on the fullerene using a perturbative delta-SCF method. Our calculated values are in good agreement with the experimental charge transfer energy.

5:04PM E1.00005 Probing protein conformations at the oil droplet–water interface using single-molecule force spectroscopy, AHMED TOUHAMI, University of Texas at Brownsville, MARCELA ALEXANDER, MILENA CORREDIG, JOHN DUTCHER, University of Guelph, Guelph Canada — We have used atomic force microscopy (AFM) imaging and single molecule force spectroscopy (SMFS) to study β-lactoglobulin (β-LG) molecules localized at the interface between oil droplets and water. To immobilize the oil droplets, we have mechanically trapped them in the pores of a filtration membrane. For this sample geometry, we have used SMFS to pull on the β-LG molecules, revealing changes in their conformation and oligomerization in response to in situ changes in pH. We have compared the present results with those obtained previously for SMFS measurements of b-LG molecules adsorbed onto mica surfaces. At neutral pH, we observe large differences between the results obtained for the two surfaces in the pulling force required to fully extend the molecules, the spacing between sawtooth peaks in the force–distance curves, and the oligomerization of the molecules. The mechanical unfolding of the adsorbed β-LG molecules at pH 2.5 was very similar for the two surfaces. For pH 9.0, we find that, for both surfaces, there is an irreversible change in the conformation of the β-LG molecules with a strong repulsion measured between the AFM tip and the β-LG molecules. This study provides insight into structural changes of this protein when adsorbed onto an oil–water interface, and demonstrates the potential of SMFS as a tool to study the structure of proteins that are important in complex matrices such as food emulsions.

5:16PM E1.00006 Analytical Comparisons of Tree Ring Data, Greenland Ice Core Temperatures and Temperature Fluctuations of the Sargasso Sea, JAMES OTTO, University of North Texas, JIM ROBERTS, University of North Texas, Denton, TX, JAI DAHIYA, Southeast Missouri State University, Cape Girardeau, MO, JAI DAHIYA COLLABORATION — Embedded in various events on Earth are data that allow us to map the temperature of the Earth over many years. In this work we have chosen the temperature fluctuations in the Sargasso sea, the changing patterns in tree ring growth and temperature fluctuations in Greenland ice core samples for comparison with a goal to understanding the patterns in global warming. Signatures have been identified that predate the Industrial Revolution, which had been blamed for much of global warming, that indicate that Earth temperatures have enjoyed numerous intervals of both global warming and global cooling. The intention of this work is not to stir controversy but to make comparisons of scientific data and processes rather than rely on popular opinion or deduction by “experts” in climatology to explain global warming.

Friday, October 26, 2012 3:30PM - 5:00PM –
Session E2 AAPT Workshop V: If Pigs Could Fly Holiday Inn Towers Cotton A - Chair: Thomas O039;Kuma, Lee College

3:30PM E2.00001 W5 - If Pigs Could Fly, TRINA CANNON, Highland Park High School — Centripetal force seems to be a challenge for students and we are typically using stoppers, string, tubes and slotted masses (that always crash to the floor). But if we use a toy that reminds them of an amusement park ride, we can get the message across and have some fun. Come and see if pigs can fly!

Friday, October 26, 2012 3:30PM - 5:00PM –
Session E3 AAPT Workshop VI: Alternate Forms of Energy Holiday Inn Towers Cotton B - Chair: Paul Williams, Austin Community College

3:30PM E3.00001 W6 - Alternate Forms of Energy, JOEL PALMER, Mesquite ISD — Build Toys! Learn Science! Is your science program preparing students for success on the Grade 5 and 8 STARR? Put the fun back in physical science and find the “E” in STEM with TeacherGeek! Explore a K-12 vertical alignment of physics concepts in energy & motion integrated with engineering practices. Participants design, build and test a Wind Turbine, they will experience engaging, hands-on lessons that can be used in their classroom to teach important physics concepts aligned with the TEKS. FREE materials to take back to your classroom!

Friday, October 26, 2012 3:30PM - 5:30PM –
Session E4 Atomic, Molecular, and Optical Physics I Holiday Inn Towers University A - Chair: Wallace Glab, Texas Tech University
3:30PM E4.00001 Phase Manipulating Refractive Index form Positive to Negative in a Four-level Atomic System, HONGJUN ZHANG, Institute for Quantum Science and Engineering and Department of Physics and Astronomy, Texas A&M University, College Station, TX, 77843, USA — We propose a four-level loop atomic scheme based on quantum coherence. Electric and magnetic responses of the medium to the probe field are discussed by taking into account the relative phase of the applied fields. It is shown that a change of the refractive index from positive to negative can occur by modulating the relative phase of the applied fields under suitable conditions. Then the medium can be switched from positive-index material to negative-index material or vice versa. In addition, a negative index material can be realized in different frequency regions by adjusting the relative phase.

3:42PM E4.00002 Topological phase transitions of attractive fermions with spin-orbit coupling in an optical lattice, CHUNLEI QU, MING GONG, CHUANWEI ZHANG, Department of Physics, The University of Texas at Dallas — It has been shown by Zhang et al [Chuanwei Zhang et al, Phys. Rev. Lett. 101, 160401 (2008)] that an effective $\pi + i\pi$ order can be created from a conventional s-wave pairing with spin-orbit coupling and Zeeman field, two essential ingredients that have already been realized in experiments by Spenner’s group at NIST. The same idea has been extended to semiconductor nanowires to search for the Majorana Fermions, which is a basic building block for the fault-tolerant quantum computation. Here we studied the spin-orbit coupled Fermi gas in a one dimensional optical lattice with finite length in the mean field theory. In our model, the s-wave interaction induced Hartree shift term has been included. We solve the Bogoliubov-de-Gennes (BdG) equation self-consistently and find that the Hartree shift and the spin-orbit coupling can greatly enlarge the topological phase area in the $h - \mu$ phase diagram. We derive an exact expression for the topological quantum phase transition. We also show that the end of the optical lattice plays an important role in the formation of topological superfluid in our model.

3:54PM E4.00003 Searching for Majorana Fermions in 2D Spin-orbit Coupled Fermi Superfluids at Finite Temperature, MING GONG, Department of Physics, the University of Texas at Dallas, Richardson, Texas, 75080 USA, GANG CHEN, Department of Physics and Astronomy, Washington State University, Pullman, Washington, 99164 USA, SUOTANG JIA, State Key Laboratory of Quantum Optics and Quantum Optics Devices, College of Physics and Electronic Engineering, Shandong University, Taiyuan 030006, CHUANWEI ZHANG, Department of Physics, the University of Texas at Dallas, Richardson, Texas, 75080 USA, CHUANWEI ZHANG TEAM, JIA COLLABORATION — Recent experimental breakthrough in realizing spin-orbit (SO) coupling for cold atoms has spurred considerable interest in the physics of 2D SO coupled Fermi superfluids, especially topological Majorana fermions (MFs) which were predicted to exist at zero temperature. However, it is well known that long-range superfluid order is destroyed in 2D by the phase fluctuation at finite temperature and the relevant physics is the Berezinskii-Kosterlitz-Thouless (BKT) transition. In this Letter, we examine finite temperature effects on SO coupled Fermi gases and show that finite temperature is indeed necessary for the observation of MFs. MFs are topologically protected by a quasiparticle energy gap which is much larger than the temperature. The restricted region for the observation of MFs have been obtained. Phys. Rev. Lett. In Press.

4:06PM E4.00004 Route to Observable Fulde-Ferrell-Larkin-Ovchinnikov Phases in 3D Spin-orbit Coupled Degenerate Fermi Gases, CHUANWEI ZHANG, MING GONG, Department of Physics, the University of Texas at Dallas, Richardson, TX, 75080 USA, ZHEN ZHENG, YUBO ZHOU, GUANGCAN GUO, Key Laboratory of Quantum Information, University of Science and Technology of China, Hefei, Anhui, 230026, People’s Republic of China — The Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) phase, a superconducting state with non-zero total momentum Cooper pairs in a large magnetic field, was first predicted about 50 years ago, and since then became an important concept in many branches of physics. In recent years, the possibility of observing FFLO states using ultracold degenerate Fermi gases has sparked tremendous interest. However, unambiguous experimental evidence for FFLO states is still elusive because of the stringent parameter requirement in experiments. In this Letter, we show that a giant parameter region for FFLO states can be obtained in 3D degenerate Fermi gases in the presence of spin-orbit coupling and an in-plane Zeeman field, two ingredients that were already developed for cold atoms in recent experiments. The predicted FFLO state is stable against quantum fluctuations due to the 3D geometry, and can be observed with experimentally already achieved temperature ($T \approx 0.05E_F$).

4:18PM E4.00005 Generation of high frequency coherent light by means of superradiant parametric resonance, ANATOLY SVIDZINSKY, LUQI YUAN, Texas A&M University — Extended atomic ensembles excited collectively act as a cavity for photons resonant with the atomic frequency $\omega$. In such a system the energy of electromagnetic field goes back and forth between the field and the atoms on a superradiant time scale determined by the collective frequency $\Omega \ll \omega$. We show that if atomic ensemble is driven by a laser with frequency $\Omega$ this can yield exponential grows of the high frequency atomic field in the direction opposite to the propagation direction of the driving field. We demonstrate that using the effect of collective parametric resonance one can, e.g., make a device which converts IR laser beam into XUV coherent light with the gain about 100 per cm. Our findings can lead to development of a new type of table-size coherent sources of XUV and X-ray radiation.

4:30PM E4.00006 Anomalous switching of optical bistability in a Bose-Einstein condensate, SHUAN YANG, Institute for Quantum Science and Engineering (IQSE) and Department of Physics and Astronomy, Texas A&M University, College Station, Texas 77843, USA, M. AL-AMRI, The National Center for Mathematics and Physics, KACSE P.O. box 6068, Riyadh 11442, Saudi Arabia, M. SUHAIL ZUBAIRY, Institute for Quantum Science and Engineering and Department of Physics and Astronomy, Texas A&M University, College Station, Texas 77843, USA — The nonlinear dynamics of the photon number in an optical cavity filled with a cigar-shaped Bose-Einstein condensate is investigated. We find that the way of adding the field is crucial to the switching close to the critical transition point. If the pump field is changed abruptly, the system may jump from one branch to the other even if the pump field intensity has not reached the critical transition point yet. This behavior is similar to the anomalous switching in the dispersive optical bistability.

4:42PM E4.00007 Nonlocal effects in light emission by N atoms: collective eigenstates and their decay rates, XIWEN ZHANG, ANATOLY SVIDZINSKY, LUQI YUAN, Texas A&M University — Collective emission of light by atomic ensemble yields fascinating phenomena of superposition and radiation trapping even at the single photon level. Here we discuss how time retardation caused by the finite value of the speed of light modifies collective evolution of atoms. In particular, we consider spherical geometry and show that nonlocal effects can substantially modify eigenstates of the system and their decay rates for small atomic samples due to large collective Lamb shift in this limit. We also show how cross-over between local (monotonic decay) and non-local (collective oscillations) dynamics occurs for an extended atomic cloud prepared by absorption of a spherical photon.
4:54PM E4.00008 Coherent control of Casimir force in a chiral medium, JABIR HAKAMI, M. SUHAIR ZUBAIRY, Institute for Quantum Science and Engineering (IQSE) and Department of Physics and Astronomy, Texas A&M University, College Station, TX 77843, USA — Chirality has been previously reported as a way to observe both attractive and repulsive Casimir forces. Here we propose the coherent control of the Casimir force between two identical atomic chiral media. A magnetic field is applied to a specific example system to split the detuning as well as the refractive indices for the two circularly polarizations, which leads to chirality. It is shown that, by controlling the strength of an external magnetic field, the Casimir force can switch between attractive and repulsive force.

5:06PM E4.00009 Resonance Fluorescence Localization Microscopy with Subwavelength Resolution1, ZEYANG LIAO, Institute for Quantum Science and Engineering and Department of Physics and Astronomy, Texas A&M University, College Station, TX 77843-4242, USA, M. AL-AMRI, The National Center for Mathematics and Physics, KACST, P.O.Box 6086, Riyadh 11442, Saudi Arabia, M. SUHAIR ZUBAIRY, Institute for Quantum Science and Engineering and Department of Physics and Astronomy, Texas A&M University, College Station, TX 77843-4242, USA — We evaluate the resonance fluorescence spectrum of a bunch of two-level atoms driven by a gradient coherent laser field. The result shows that we can determine the positions of atoms from the spectrum even when the atoms locate within subwavelength range and the dipole-dipole interaction is significant. This far-field resonance fluorescence localization microscopy method does not require point-by-point scanning and it may be more time-efficient.

1This research of Z. L is supported by Heep Fellowship. This work is supported by grants from the King Abdulaziz City for Science and Technology (KACST) and the Qatar National Research Fund (QNRF) under the NPRP project.

5:18PM E4.00010 Challenging subjects behind using a liquid crystal display as an optical lens, JAVAD R. GATABI, WILHELMUS GEERTS, Department of Physics, Texas State University at San Marcos, DAN TAMIR, Department of Computer Science, Texas State University at San Marcos — Adjustable lenses are widely used in compound optical systems, including cameras and microscopes. Different techniques are used to build lenses with adjustable focusing. One of the recent techniques uses a liquid crystal spatial light modulator (LC-SLM) to generate the adjustable lens phase function. LC-SLMs provide a robust capability to design fast adjustable optical components without any movable mechanical parts. This paper presents a general method to design a compound lens with an adjustable focal length using a LC-SLM for a laser lithography application. The article describes the challenging matters behind using phase modulators in an imaging system. The focal lengths and minimum accessible focal lengths have been calculated for different LC-SLMs, taking into account the modulator resolution, bit depth and aperture size. A new type of random aberration caused by bit depth limitation is introduced and its dependency on the focal lengths is discussed. The proposed theoretical model to determine the lens parameters is compared with numerical and experimental data. The experimental results agree well with the theory. The focusing capabilities of a Holofey LC-SLM will be demonstrated.

Friday, October 26, 2012 3:30PM - 5:18PM – Session E5 Nanosience Holiday Inn Towers University B - Chair: Mark Holtz, Texas Tech University

3:30PM E5.00001 Methods of measuring chitosan and gold interaction in the formation of biocompatible gold nanoparticles, SAMANTHA FRANKLIN, KELLY NASH, ZANNATUL YASMIN, University of Texas at San Antonio — Chitosan, a macromolecule, taken from crustaceans, has been used to create biocompatible gold nanoparticles (AuNPs). In this study, the formation of the gold nanoparticles synthesized with the chitosan solution was measured using different UV methods. The UV light is used to reduce the Au ions in the solution into gold nanoparticles, in which the result is biocompatible nanoparticles upon reduction. Different molar concentrations of a monovalent salt, such as sodium chloride (NaCl), were added to the chitosan and gold solution, and the interactions of the chitosan and NaCl with the gold formation were also measured. This was done to study the influence of the chitosan on the shape and size of the nanoparticles that formed. In this study, two different types of UV light were used: a Spectrolinker XL-1500UV Crosslinker with a wavelength (λ) at 365nm and an Nd:YAG laser with λ at 355nm. Samples that were measured were dilute solutions and concentrations, which allow for measuring morphology with dependent optical response that can be observed with certain optical spectra systems. Formation of the particles were studied using scanning electron microscopy (SEM) and a dynamic light scattering system (DLS) that allowed for measurement of the zeta-potential (ζ).

3:42PM E5.00002 Optical Wide-Field Nanoscope, CHARLES REGAN, AYRTON BERNUSSI, Texas Tech University, NanoTech Center and Department of Electrical Engineering, LUIS GRAVE DE PERALTA, Texas Tech University, NanoTech Center and Department of Physics — We describe the wide-field optical nanomaging capabilities of a novel nanoscope based on the surface plasmon polariton (SPP) tomography technique. In contrast to other optical subwavelength resolution techniques, in our approach for imaging nanosize features, enhanced evanescent waves are coupled to the far-field via leakage radiation associated with SPPs excited by near-field fluorescence; therefore wide-field images which are not out-of-plane diffraction-limited are formed directly in the microscope’s camera.

3:54PM E5.00003 Experimental Investigation of Crystalline Structure of Synthetic Opals Using Light Scattering and Diffraction Methods, LILIANA RUIZ DIAZ, University of Texas at Brownsville, AINUR KOSHIKINA-YEVA, Nazarbayev University, MALIK RAKHMANOV, University of Texas at Brownsville, ANVAR ZAKHIDOV, Alan G. MacDiarmid NanoTech Institute, University of Texas at Dallas — Synthetic opals are 3-dimensional photonic crystals made of mono-dispersed nanoparticle assembles with self-assembly techniques. Such opals usually consist of multiple domains of roughly homogeneous regions which are randomly oriented with respect each other. We analyze the crystalline structure of individual domains in opals with diffraction measurements. The diffraction patterns were produced by focusing broadband white light onto a single domain which scattered the reflected light on a screen. We observed strong spatial dispersion in the scattered field which we analyzed using a semi-analytical model. The model allows us to include arbitrary crystalline lattices and introduce point, line, and plane defects in the domains. These experiments give us information about the structure of the opal, orientation of its domains, and presence of the crystalline defects.

4:06PM E5.00004 Nanocomposite materials for radiation detection, SUNIL SAHI, University of Texas at Arlington — Zinc Oxide (ZnO) based scintillators are an interest of research due to its fast decay time. Scintillator requirements include the high-light yield, fast decay time and high density. ZnO based scintillators have relatively low light yield and low density. The quantum efficiency of ZnO based scintillators can be improved by energy transfer from Cerium fluoride (CeF3). Herein, CeF3/ZnO nanocomposites were synthesized to enhance the light output of ZnO. As synthesized, nanocomposites were characterized with XRD, Photoluminescence and UV-Vis. The nanocomposites show significant enhancement in the photoluminescence intensity of the ZnO due to the energy transfer from CeF3 nanoparticles.
4:18PM E5.00005 Study of Fluorescent Defect Properties in Nanodiamond . JOSEPH KIMBALL, T. ZERDA, TCU, Department of Physics and Astronomy, B. ROUT, University of North Texas, Department of Physics, A. OSIPOV, V. N. Bakul Institute for Superhard Materials — The unique properties of fluorescent nanodiamonds make nanodiamonds preferred candidates for optical labels in biological and medical imaging. The basic theory behind the diamond crystal lattice and point defects within nanodiamond responsible for the fluorescence emitting nitrogen vacancy (N-V) center are presented. To fully implement and understand their optical and physical properties, this study uses two different techniques to create in raw diamonds the defects responsible for the emission of a photostable spectrum containing Zero-Phonon Lines at 578 nm and 638 nm with fluorescent lifetimes ranging from 8-15 ns. Two different methods, irradiation and HPHT, are used to create the sought after (N-V) center.

4:30PM E5.00006 Double Slit Diffraction Experiments with Surface Plasmon Polaritons . KAMRUL ALAM, Texas Tech University, LUIS GRAVE-DE-PERALTA, Applied Physical Society — Young's double slit experiment is the most famous interference experiment. To fully implement and understand their optical and physical properties, this study uses two different techniques to create in raw diamonds the defects responsible for the emission of a photostable spectrum containing Zero-Phonon Lines at 578 nm and 638 nm with fluorescent lifetimes ranging from 8-15 ns. Two different methods, irradiation and HPHT, are used to create the sought after (N-V) center.

4:42PM E5.00007 Practical metamaterial lenses for plasmonic applications1 . ONGARD THIABGOM, Department of Physics, Texas Tech University, Lubbock, TX 79409, USA, CHARLES REGAN, AYRTON BERNUSSI, Department of Electrical and Computer Engineering and Nano Tech Center, Texas Tech University, Lubbock TX 79409, USA, LUIS GRAVE DE PERALTA, Department of Physics and Nano Tech Center, Texas Tech University, Lubbock, TX 79409, USA — We explored two-dimensional plasmonic metamaterial lenses using surface plasmon polariton (SPP) tomography techniques. Metamaterial lenses were defined by a periodic array of air holes patterned on a thin film polymethyl methacrylate (PMMA) deposited in a typical Au/glass nanostructure. Surface emission and Fourier-plane images of SPP beams through the plasmonic lenses were analyzed to extract the lens focal length. The experimental extracted values show very good agreement to calculated values using conventional thin-lens equation. These practical plasmonic lenses are attractive for integrated plasmonic devices and lab-on-chip applications.

4:54PM E5.00008 Surface plasmon excitations at well-defined and not-so-well-defined interfaces . KUNAL TIWARI, ANKIT SINGH, SURESH SHARMA, University of Texas at Arlington — It is well known that travelling wave surface plasmon excitations (SPEs) can be generated by using well-defined Kretschmann geometry, in which a sample is sandwiched between a thin noble-metal film coating on the base of a high-index prism and glass slide. The onset of SPEs is evidenced by loss in the intensity of totally reflected light at a certain angle greater than the critical angle for total reflection. We have investigated the onset of SPEs in several samples, having both well-defined and not-so-well-defined metal/dielectric interfaces. Whereas SPEs at the first type of interfaces is understood, their occurrence at not-so-well-defined interfaces is hardly known. We have investigated the onset of SPEs at both types of interfaces in a series of samples prepared by using mixtures of nematic liquid crystal and 14 nm diameter Au NPs dispersions. In this presentation, we will show results from a series of measurements and simulations.

5:06PM E5.00009 Wide-Angle Polarization-Dependent Diffraction in a Silicon Nano-Patterned Membrane Reflector . ANTON GRIBOVSKIY, TRAVIS MILLER, MALIK RAKHMANOV, Department of Physics & Astronomy, University of Texas at Brownsville, SANTHAD CHUWONGIN, DEYIN ZHAO, WEIDONG ZHOU, Department of Electrical Engineering, University of Texas at Arlington — Silicon nano-patterned membrane reflectors (two-dimensional photonic crystals) are designed for use as broad-band reflectors or narrow-band optical filters and are capable of high reflectivity at selected wavelengths. High-sensitivity off-axis measurements reveal a wide-angle diffraction pattern produced by these reflectors. We conducted experiments using four laser wavelengths: 405, 635, 1064, and 1550 nm. For visible light, the diffraction pattern consists of a two-dimensional array of isolated bright spots. For infrared light, the diffraction changes drastically and a cross-shaped pattern appears in the reflected field. The pattern stretches almost 180 degrees in two orthogonal directions and strongly depends on the polarization of the incident beam. The intensity variations are present in the branch of the pattern which is perpendicular to the polarization of the incident beam. This effect modifies the reflective properties of the nano-patterned membranes and must be taken into account when considering the performance of these devices.

Friday, October 26, 2012 3:30PM - 4:18PM –

Session E6 Outreach, Education, and AAPT Holiday Inn Towers Heritage - Chair: Jennifer Steele, Trinity University

3:30PM E6.00001 Peer Pressure Road Trip 2012 – A Report . OLIVIA POPNOE, Angelo State University — Each year since 2005 the Angelo State University SPS “Peer Pressure Team” has travelled for a week in May to promote physics and other sciences for grades K-12. This year, the Peer Pressure Team visited schools in West Texas and New Mexico. This was the first year the team has traveled outside of Texas, inspired by the SPS 2012 theme “Physics Beyond Borders.” The purpose of the Road Tours is to encourage an interest in science in children in grades K-12 and give experience in presenting and explaining physics to the undergraduate volunteer. The team attended over 80 locations selected based on socioeconomic need and underrepresentation in physics, as well as other sciences. During this week, the Peer Pressure Team saw about 1,500 students over 10 shows. Surveys were given to teachers post-demonstration to have students complete and return so the Team could gauge the effectiveness of the outreach program. In addition, the surveys allow the Team to determine which demonstrations had the most impact. We present the details of this year’s road trip with the results and analysis of the survey data.

3:42PM E6.00002 Physics of climate change, taught as a topics a course for undergraduate physics majors . MICHAEL SADLER, Abilene Christian University — While anthropogenic (human-caused) climate change is generally accepted in the scientific community, there is considerable skepticism among the general population. Science students are often asked by their peers, family members, and others, whether they “believe” climate change is occurring and what should be done about it (if anything). While the pertinent material is covered in undergraduate physics courses, it helps to review the basics in order to develop an educated perspective on this topic that is very volatile (socially and politically). The basic topics are introductory quantum mechanics (discrete energy levels of atomic systems), molecular spectroscopy, blackbody radiation, and appreciation for the scientific method (particularly peer-reviewed research). These topics are usually covered in undergraduate modern physics and thermodynamics courses, but a separate course on climate change (taught in Spring 2012) helped “put things together” for both the students and their professor.
3:54PM E6.00003 Some Activities in the Regional Collaborative for Excellence in Science Teaching , JIM ROBERTS, BETTY CROCKER, University of North Texas, BETTY CROCKER COLLABORATION — Select activities that are “teacher and student engaging.” will be presented along with a discussion of the goals and objectives of the program. Science and mathematics teachers are recruited from high minority low socio-economic schools to learn science content in an engaging environment of hands-on activities to develop an understanding of basic chemistry, biological cycles, effective teaching strategies, state standards, and how scientific and technological devices work. Participants are taught how to design 5E lesson plans, design pre and post-tests of lessons, and incorporate research based effective teaching models into their class rooms. Mentor Collaborative teachers are recruited to act as participants, recruiters, and as mentor teachers for teachers who are joining each cycle of the program.

4:06PM E6.00004 Waters Rockets for Teaching Momentum and Energy Concepts , JIM SIZEMORE, Tyler Junior College, R.J. PARISH, JAMES T. HOOTEN, Center for Earth & Space Science Education at Tyler Junior College — Concepts regarding regard weight and momentum are especially difficult for students to grasp and concrete examples are valuable. We will discuss, and show video, of launching water rockets using standard plastic soda and water bottles and describe the launchers composed of PVC pipe and a bicycle pump. We pose the question to students of the ratio of water to air that achieves the greatest time-of-flight. Immediate feedback is obtained by immediately testing students’ hypotheses. After several launches the students understanding of Newton’s Third Law and momentum and energy concepts improves. This is an engaging activity, students enjoy watching their instructors become thoroughly drenched, and students are enthusiastic. This enthusiasm, fun, and immediate testing of hypotheses reinforce momentum and energy concepts as will be shown by questionnaire results.

Friday, October 26, 2012 3:30PM - 5:46PM –
Session E7 Invited & Contributed Papers: Condensed Matter & Materials Physics II
Holiday Inn Towers Petroleum B - Chair: Wilhelmus Geerts, Texas State University

3:30PM E7.00001 Integration of functional oxides and semiconductors , ALEX DEMKOV, The University of Texas at Austin — The astounding progress of recent years in the area of oxide deposition has made possible the creation of oxide heterstructures with atomically abrupt interfaces. The ability to control the length scale, strain, and orbital order in these materials structures offers a uniquely rich toolbox for condensed matter physicists. Because the oxide layers are very thin, the physics is often controlled by the boundary layers. The electronic properties of oxide interfaces are governed by a subtle interplay of many competing interactions such as strain, polar catastrophe, electron correlation, and Jahn-Teller coupling, as well as by defects and phase stability. It is not clear which, if any, of these newly discovered systems will find applications in future high-tech devices. However, they undoubtedly hold tremendous promise, particularly when integrated with conventional semiconductors such as Si. In this talk I will review our recent results in theoretical modeling and experimental realization of several epitaxial oxide heterostructures. I will set the stage with a brief discussion of extrinsic magnetoelectric coupling at the interface of a perovskite ferroelectric and conventional ferromagnet. I will then describe our recent successful attempt to integrate anatase, a photo-catalytic polymorph of TiO2, with Si (001) using molecular beam epitaxy. In conclusion, I will talk about strain stabilized ferromagnetism in correlated LaCoO3 (LCO) and monolithic integration of LCO and Si for possible applications in spintronics. The integration is achieved via the single crystal Sr5Ti4O11 (STO) buffer epitaxially grown on Si. Superconducting quantum interference device magnetization measurements show that, unlike the bulk material, the ground state of the strained LaCoO3 on silicon is ferromagnetic with a Tc of 85 K.

4:10PM E7.00002 Electronic structure of self-passivated Cu-delafossite nanocrystals1 , MUHAMMAD N. HUDA, Department of Physics, University of Texas at Arlington, Arlington, Texas 76019 — A unique class of highly stable, self-saturated and self-charge-compensated delafossite nanocrystals has been identified. The density functional theory (DFT) study of structural and electronic properties of these nano-crystalline Cu-based delafossites will be presented. To have a better estimate of the electronic excitation energies, and consequently the optical gap, time dependent DFT has been employed as well. The goal is to show, first of all, that these unique set of nanocrystals exists, and to study whether the nano-phase can enhance the electronic properties for its application as photocatalysts.

1Supported by DOE and NSF.

4:22PM E7.00003 Positive Muonium in Indium Oxide1, BRITTANY BAKER, Texas Tech University, Y.G. CELEBI, Istanbul University, R.L. LICHTI, P.W. MENGYAN, Texas Tech University — Using Muon Spin Relaxation (MuSR) measurements, we are investigating the diffusion of the positively charged ionic state of muonium (muonium is a muon plus a captured electron) defects in In2O3. The muonium is treated as a light hydrogen analog. Zero field (ZF) measurements were taken from 100 K up to 750 K. This range of temperatures allows for investigation of how the muonium defect center diffuses through the material. The global diffusion barrier energy is a semiconducting material in the class of transparent conducting oxides (TCO) that are commonly being used in semiconductor optical devices, such as solar cells and LEDs.

1This research was supported by the National Science Foundation Partnership for Research and Education in Materials (NSF-PREM) Grant No. DMR-0934218.

4:34PM E7.00004 Rare earth doped upconverting nano and micron size particles for photonic applications1 , MADHAB POKHREL, AJITH KUMAR GANGADHARAN, DHIRAJ KUMAR SARDAR, University of Texas at San Antonio — Upconverting nano and micron size particles are known to exhibit extraordinary characteristics and have a wide range of applications which utilizes their unique properties. A thorough optical characterization of the rare earth doped materials is of critical importance in evaluating them as potential for various photonic applications. My studies include absorption, excitation, emission, and fluorescence lifetime measurements in upconverting powder. Along with the spectroscopic analysis, we have successfully measured the quantum yield for the different concentration of Er/Yb doped M2O3S (M=La,Y, Gd). We have found that quantum yield in Er/Yb doped M2O3S is power dependent. Measurements done under the identical condition with respect to reported most efficient upconverting phosphor NaYF4 doped with Er/Yb show that the new phosphor system is three times more efficient. The high quantum yield under near infrared excitation enables the application of upconverting phosphors as potential candidate for biomedical imaging application. Luminescence measurement shows that present upconverting phosphors system is also powerful candidates for display application.
14 times slower than the MSU result. The decay time constant found was 3700 for a period of one week, then shut off for one week, and reversed for another week. The charging rate was found to be 7

LEDs are induced shifts, making extraction of the junction temperature approximate at best. We present a method involving a straightforward electrical measurement of the forward voltage and drive current. By controlling the ambient temperature of the junction during small pulsed currents, a calibration curve for \( V_f \) vs \( T_j \) can be established and used to determine the junction temperature during normal operation levels. The details of the measurement will be discussed as well as the effects of the junction temperature on the electroluminescence emission peak for various sample LEDs.

We sought to verify the MSU result by measuring the induced charge distribution from an ESD with a Kelvin capacitive probe. A fused silica optic was exposed to an ESD and then moved via a motorized translation stage to the probe for measurement at high vacuum (10

Contrast to the "rigid body approximation," the core size and core shape in our calculations were varied to achieve the energy minimum for magnetization distribution in the vortex, curling in plane everywhere except the "core," where it is out of plane. Interest in switching of magnetic vortices in nanodots is stimulated by their potential application for magnetic memories and nano-oscillators. By combining analytical and micromagnetic techniques, we calculated energy barriers for vortex switching in 20 nm-thick iron dots as a function of applied in-plane field and dot diameter. Using analytical formula for magnetization distribution in the vortex, we performed micromagnetic calculations of the dot energy for different vortex core positions. In contrast to the "rigid body approximation," the core size and core shape in our calculations were varied to achieve the energy minimum for every core displacement. The energy barriers required for vortex nucleation and annihilation were calculated as a function of magnetic field. By comparing these barriers to the thermal energy \( k_B T \) we obtained the temperature dependences of the vortex nucleation and annihilation fields in good agreement with the experiment.

Work is supported by Texas A&M University, TAMU-CONACyT Collaborative Research Program.

Charging of a Fused Silica Optic by an Electrostatic Drive

According to measurements at Moscow State University (MSU), the ESD contributes displacement noise by redistributing charge on the optic. We sought to verify the MSU result by measuring the induced charge distribution from an ESD with a Kelvin capacitive probe. A fused silica optic was exposed to an ESD and then moved via a motorized translation stage to the probe for measurement at high vacuum (10

Calibration with a known voltage source determined a sensitivity 1V = 6 x 10^{-12} C/cm². A voltage of \( \pm 600 \) V was applied to the electrodes for a period of one week, then shut off for one week, and reversed for another week. The charging rate was found to be 7 x 10^{-15} C/cm²/hr, fourteen times slower than the MSU result. The decay time constant found was 3700 ± 900 hours, about 3 times faster than the MSU result.

Supported by the National Science Foundation through grant PHY-1068760.
3:30PM E8.00001 Visualizing Events and Optimizing Higgs Boson Analysis at DØ1
JOHN SANDY, Texas Tech University, MICHAEL COOKE, RYUJI YAMADA, Fermi National Accelerator Laboratory, D-ZERO COLLABORATION — With the announcement of a new boson at the LHC, presentation and completion of the final analysis at D-Zero becomes a priority. The 3-D event visualization software D0Cafvis was debugged and used to create event displays of Higgs candidate events for use in presentations at the DØ collaboration. Following that work, optimizing the Higgs analysis began by training secondary Multi-Variate Analysis (MVA) tools to better separate Higgs events from the many Standard Model backgrounds that are produced in high energy collisions. These new MVAs have been added to the analysis framework at D-Zero and are now being used to complete the final analysis of the Tevatron’s full Run IIb data set.

1Summer Undergraduate Laboratory Internship (SULI)

3:42PM E8.00002 Giant resonances in 40Ca and 48Ca, MASON ANDERS, SHALOM SHLOMO, Cyclotron Institute at Texas A&M University — It is well known that the energies of the compression modes, the isoscalar giant monopole resonance (ISGMR) and isoscalar giant dipole resonance (ISGDR), are very sensitive to the value of the compressibility, $K_{NM}$. Also the energies of the isovector giant resonances, in particular, the isovector giant dipole resonance (IVGDR), are sensitive to the density dependence of the symmetry energy, J. Furthermore, information on the density dependence of J can also be obtained by studying the isotopic dependence of strength functions, such as the difference between the strength functions of 40Ca and 48Ca. We will present results of fully self-consistent Hartree Fock based random phase approximation calculations of the strength functions and centroid energies $E_{CEN}$ of isoscalar (T = 0) and isovector (T = 1) giant resonances of multipoles L = 0 - 3 in 40Ca and 48Ca, using a wide range of commonly employed Skyrme type nucleon-nucleon effective interactions. We will discuss the sensitivity of $E_{CEN}$ and of the differences $E_{CEN}(48Ca) - E_{CEN}(40Ca)$ to physical quantities, such as nuclear mater incompressibility coefficient and symmetry energy, associated with the effective nucleon-nucleon interactions and compare the results with available experimental data.

3:54PM E8.00003 Medium Effects in Nuclear Direct Reactions1, MESUT KARAKOC2, CARLOS BERTULANI, Department of Physics and Astronomy, Texas A&M University-Commerce, Commerce, Texas 75429-3011, USA — I will discuss the effects of medium corrections in direct reactions at intermediate energies, above 50 MeV/nucleon. We have used the t-rho-rho microscopic method to deduce optical potentials based on an effective nucleon-nucleon (NN) cross section. As elastic scattering data at intermediate energies are scarce, knockout reactions are used for the purpose. Our results are compared with those obtained with free NN cross sections. We show that medium effects may lead to sizable modifications for collisions at intermediate energies and that they are more pronounced in reactions involving weakly bound nuclei.

1This work was partially supported by the US-DOE grants DE-SC004972 and DE-FG02-08ER41533 and DE-FG02-10ER41706, and by the Research Corporation.
2Permanent address: Department of Physics, Akdeniz University, TR-07058 Antalya, Turkey

4:06PM E8.00004 Optimizing Polar Asymmetry Observables at Colliders, SANTOSH ADHIKARI, Southern Methodist University — Polar angle asymmetries are simple, intuitive, model-independent observables for spin identification of new physics at colliders. We argue that the second moment of the normalized polar differential cross section is typically optimal in the case of Drell-Yan boson resonances at pp colliders. Our arguments are based on explicitly investigating a range of angular weight functions of the decay of spin 0,1,2 bosons to massless spin 1/2 or 1 particles.

4:18PM E8.00005 Electron Identification Studies for the Level 1 Trigger Upgrade, LAST FEREMENGA, University of Texas at Arlington, MARC-ANDRE PLEIER, FRANCESCO LANNI, Brookhaven National Laboratory, ATLAS COLLABORATION — We show that it is not possible to reject neutral pions from electrons at Level 1 trigger of the ATLAS trigger system. The lateral profiles of electrons and neutral pions are different when the interaction point of the colliding protons is at $z = 0$ and a good rejection criteria is achieved. Although this rejection criteria is stable against increasing pileup, it fails for a more realistic model of the luminous profile of the proton beam. A variable used at Level 2 trigger is also shown in this note to be unstable against increasing pileup.

3:30PM - 3:30PM — Session E9 Posters II: Outreach, PER, Atomic & Molecular Physics, General Physics

E9.00001 The Effect of Problems Format on Student’s Answer, GANESH CHAPAGAIN, BETH THACKER, Texas Tech University — We have analyzed the effect of problem format on students’ answers to quiz questions. Students were given the same question in three different formats: calculate ranking and multiple choice ranking. We compared the correctness of the students’ answers and the types of incorrect answers in each of the different formats. We also compared to a similar, previous study done with a different quiz question written in different formats: multiple choice, explain your reasoning and ranking.

E9.00002 Effect of Humidity and Hydrophobicity on the Tribological Properties of Self-Assembled Monolayers, YEN-CHIH LIAO, WILLIAM HARGROVE, BRANDON WEEKS, Texas Tech University — In this study, the tribological properties of two distinctive alkanethiol SAMs, 16-mercaptohexadecanoic acid (MHA) and 1-octadecanethiol (ODT) on gold substrates in various humidity conditions were examined by lateral force microscopy (LFM). The results suggest that hydrophobic ODT SAM is insensitive to humidity. The difference of lateral force signal is within ±10% regardless of humidity. The lateral force signal of hydrophilic MHA SAMs has a significant decrease in signal in humid environments. The influence of bulk water was also investigated by LFM. By imaging under water, the capillary force is eliminated on ODT SAMs, which leads to a lower lateral force. However, the lateral force image was reversed on MHA SAMs, which suggested that hydrophobic forces dominated in water.

E9.00003 Peer Pressure at Angelo State University, JEREMY JOHNSON, HARDIN DUNHAM, TONI SAUNCY, Department of Physics & Geosciences, Angelo State University — Since 2005 a select group of students from the Society of Physics Students at Angelo State University have joined together to form the basis of the organization’s outreach program. This group is known as the Peer Pressure Team. Over the years this organization has performed at numerous outreach events, reaching tens-of-thousands of elementary, junior high, and high school students across the country. Each year for the last 7 years the Peer Pressure Team has traveled for a week to various schools performing for thousands of students. We present here the structure of the group, demonstrations, and methods for involving the groups presented to.
E9.00004 A Study of Long Term Peer Engagement - The ALPHAS Program, ASHLEY WILSON, HARDIN DUNHAM, Department of Physics & Geosciences, Angelo State University — We present the format, the engagement methods, and the assessment scheme for a year-long SPS outreach program at a local elementary school. The ALPHAS (Alta Loma Peers Helping the Advancement of Science) Program’s primary goal is to identify deficiencies in science objectives and provide enrichment activities through the participation of the SPS Peer Pressure Team in order to help correct the identified deficiencies. For this thirty-week long program we present initial data and identify projected outcomes.

E9.00005 The Physics After School Special (PASS) Program, JAMES ANDERSON, HARDIN DUNHAM, TONI SAUNCY, Department of Physics & Geosciences, Angelo State University — The Physics After School Special program, or PASS program, funded by the Marsh White award, was a collaborative enrichment program between Angelo State University’s SPS chapter and the local YMCA. The overall goal of this program was to educate young children in physical concepts, educate through hands on activities, to build a mentor-mentee relationship between the children and our SPS volunteers, and to encourage interest in scientific fields. Originally planned to for second to fifth grade students the program was implemented with kindergarten to fourth grade students. This proved to challenge the curriculum but adjustments were made to become more suitable to the age group. We present the program specifics and share results of this outreach program.

E9.00006 ABSTRACT MOVED TO L1.00009 —

E9.00007 Crystallographic analysis using electron transmission by graphite1, BRYAN NEAL, NICK LANNING, CRISTIAN BAHRIM, Department of Physics, Lamar University — The transmission of electrons through graphite crystals reveals quantum details about the interaction between projectile electrons and the atoms in the crystal. The projectile electrons are Fourier transformed into wave packets by the K-shell and L-shell electrons of Carbon atoms in the ground state. The formation of a wave packet in crystals can be explained using Heisenberg’s Uncertainty Principle. The quick passage of projectile electrons through the crystal is due to the Pauli Exclusion Principle which forbids the projectile electrons from occupying quantum states in the ground state electronic configuration of Carbon. The analysis of the electron diffraction pattern indicates the effective electronic charge density responsible for spreading the initially well-collimated electron beam into a broad diffraction maximum with a Lorentzian shape in the center. This Lorentzian profile allows us to extract the characteristic time of the projectile electron – atom interaction. Furthermore, the analysis of the interference maxima allows us to calculate the length of the C-C bond, the crystal lattice, and the spacing between the graphene layers of a hexagonal graphite crystal.

1The project was sponsored by the STAIRSTEP program under the NSF-DUE grant # 0757057.

E9.00008 Controlling the Goos-Hänchen and Imbert-Fedorov shifts via pump and driving field, SAEED ASIRI1, JINGPING XU2, Institute of Quantum Science and Engineering (IQSE), and Department of Physics and Astronomy, Texas A&M University, College Station, Texas 77843-4242, M. AL-AMRI, The National Center for Mathematics and Physics, KACST, P. O. Box 6086, Riyadh 11442, Saudi Arabia, M. SUHAIL ZUBAIRY, Institute of Quantum Science and Engineering (IQSE), and Department of Physics and Astronomy, Texas A&M University, College Station, Texas 77843-4242 — We consider a three-level atomic medium and discuss how to control the Goos-Hänchen and Imbert-Fedorov shifts for a circular polarized Gaussian beam via pump and coherent driving field applied to the atomic medium. The susceptibility of the atomic medium can be adjusted by changing the driving field and pump. Consequently, for a fixed driving field, by turning on and off the pump the amplitude and the direction of the lateral and transverse shifts of such beam can be changed. We adopt stationary phase and beam simulation methods to derive our results.

1The National Center for Mathematics and Physics, KACST, P. O. Box 6086, Riyadh 11442, Saudi Arabia
2Key laboratory of advanced micro-structure materials, Ministry of Education, Department of Physics, Tongji University, Shanghai 200092, China

E9.00009 Exploring the Quantum Limit for Surface Plasmon Polaritons, DANIEL DOMINGUEZ, LUIS GRAVE DE PERALTA, Texas Tech University, QUANTUM OPTICS GROUP TEAM — This work explores the quantum limit of Surface Plasmon Polariton (SPP) generation based on Bohr’s Correspondence Principle, i.e. that the quantum description of a phenomenon must converge to its classical counterpart in the limit of large numbers. Specifically, this work addresses the excitation and detection of single-photon SPPs. This is accomplished by first exploring whether SPPs can be excited using an extremely low intensity pump beam; and then by using Spontaneous Parametric Down-Conversion (SPDC) as a source of single photons for SPP excitation. The granular effect of light is demonstrated by integrating the Hanbury Brown and Twiss experiment into the SPP detection scheme and measuring the degree of second order coherence of both the SPP excitation beam and the SPP leakage radiation. The results demonstrate that by using a beam of single photons as a source of excitation, one can indeed generate single-photon SPP’s whose leakage radiation remains temporally spaced.

E9.00010 Pump Wavelength Dependent Time Correlated Photoluminescence Spectroscopy of Giant Quantum Dots, AALAP VERMA, SIDDHARTH SAMPAT, ANTON MALKO, University of Texas at Dallas, JENNIFER HOLLINGSWORTH, YAGNASENI GHOSH, HAN HTOON, Los Alamos National Laboratory — Quantum dots have gained significance as high quantum yield photon sources in many applications. A new breed of “giant” quantum dots (gQDs) developed at Los Alamos National Labs consisting of a CdSe core coated with several mono-layers of CdS have shown suppressed blinking [1]. gQDs have been shown to exhibit two types of blinking – Type A, associated with short off-state lifetime and Type B, characterized by long off-state lifetime [2]. However, the appearance of A or B type blinking is unpredictable and intermittent. We conduct pump wavelength dependent time correlated PL spectroscopy on gQDs to narrow down the causes of appearance of these blinking types. Our results suggest that there is a faster PL decay when excitons are pumped in the shell as compared to when only the core is pumped. This suggests that pumping the core opens up various non radiative decay channels, some of which may lead to type B blinking. Studies on dependence of blinking rates on pump wavelength are currently ongoing.

[1] Malko et al; Pump Intensity and Shell Thickness Dependent Evolution of Photoluminescence Blinking in Individual Core/Shell CdSe/CdS Nanocrystals; n1005272
[2] Galland et al; Two types of luminescence blinking revealed by spectroelectrochemistry of single quantum dots; nature10569
E9.00011 Exact quantum dynamics calculations using a symmetrized Gaussian basis, THOMAS HALVERSON, BILL POIRIER, Texas Tech University — In a series of earlier articles, a new method was introduced for performing exact quantum dynamics calculations. The method uses a “weyllet” basis set (orthogonalized Weyl-Heisenberg wavelets), combined with phase space truncation, to defeat the exponential scaling of CPU effort with system dimensionality that has long plagued such calculations. Here, we present results obtained using a basis of momentum-symmetrized Gaussians. Despite being non-orthogonal, symmetrized Gaussians do exhibit collective locality, allowing for effective phase space truncation. Application to both isotropic uncoupled harmonic oscillators and coupled anharmonic oscillators are discussed. Results for uncoupled systems up to 15 dimensions are compared with previous weyllet calculations and found to be essentially just as efficient. A “universal” code has been written, which is dimensionally independent, and which also exploits massively parallel algorithms. Using the new codes, calculations up to 27 dimensions have been achieved. Lastly, symmetrized Gaussian calculations for coupled anharmonic oscillators are analyzed, and compared to first order degenerate perturbation theory.

E9.00012 Terahertz time-domain spectroscopy of cotton sheets, YANHAN ZHU, Department of Electrical and Computer Engineering and Nano Tech Center, Texas Tech University, Lubbock, TX 79409, MARK HOLTZ, Department of Physics and Nano Tech Center, Texas Tech University, Lubbock, TX 79409, AKRYTON BERNUSI, Department of Electrical and Computer Engineering and Nano Tech Center, Texas Tech University, Lubbock, TX 79409 — The transmission of cotton is measured using time-domain spectroscopy in the terahertz (THz) frequency range, from 0.1 to 1.5 THz. An effective medium approximation is used to model the combined cotton and air comprising the samples, and the refractive index of cotton fibers determined. The imaginary part of the refractive index varies across this frequency range with corresponding attenuation coefficient increasing from ~ 2 to ~ 12 cm⁻¹, while the real part remains constant at n ~ 1.144. The effect of moisture content is systematically examined and absorption of the samples determined. Concealed material detection was tested by measuring the 1.44-THz absorption band of representative substance D-Glucose embedded in cotton sheets.

E9.00013 How to detect photons passing through interference minima, LUIS GRAVE DE PERALTA, DANIEL DOMINGUEZ, APS — Surface plasmon polariton (SPP) excitations traveling in opposite directions were used to produce SPP standing waves. We show that SPP tomography in a quantum eraser arrangement has the remarkable capability of permitting the observation of light passing through the dark fringes of a standing wave interference pattern. Classical and phenomenological quantum descriptions of the experiments are presented.

E9.00014 Graphene in a Thermoelectric Battery, KEITH PECK, Stephen F. Austin State University — This work looks at a thermoelectric battery that uses graphene and possible changes to the graphene to effect a change in the battery that will increase the voltage output. The differences in electrode coating processes, graphene substrates, and chemical solution, are investigated for their effects on the voltage output of the battery. We also look into possible effects of graphene orientation in the solution on voltage output as well as the variation of the voltage with temperature. This work is based on the paper “Self-Charged Graphene Battery Harvests Electricity from Thermal Energy of the Environment.”

E9.00015 A Summer Research Experience in Particle Physics Using Skype, CURRAN JOHNSTON, STEVEN ALEXANDER, Southwestern University, A.K. MAHMOOD, Bellarmine University — This last summer I did research in particle physics as part of a “remote REU.” This poster will describe that experience and the results of my project which was to experimentally verify the mass ranges of the Z’ boson. Data from the LHC’s Atlas detector was filtered by computers to select for likely Z boson decays; my work was in noting all instances of Z or Z’ boson decays in one thousand events and their masses, separating the Z from Z’ bosons, and generating histograms of the masses.

E9.00016 Measurement of the Top Quark Pair Production Cross Section using Muon+jets Data at CDF, DAVID TO, Angelo State University, RACHEL BERNICK, Cornell University, WESLEY KETCHUM, YOUNG-KEE KIM, University of Chicago — We have measured a cross section of the top quark pair production from the data at CDF collected of many years. The cross section was determined by using a data sample with an integrated luminosity of 6.6 ± 396 fb⁻¹. We try to reconstruct top pair events by analyzing decays of leptons+jets in particular we look for μν+jets. The sample had 7975 total events; we were able to provide the right cuts to give us 25 ± 5 top pair production events with a background of 6.19 ± 3.039 We were able to find the cross section for top pair production to be σ = 7.748 ± 2.07 pb using an acceptance of A = 0.003677.

E9.00017 Optical Foucault Pendulum: photons and the Coriolis effect, CHARLES ROGERS, Texas A&M University - Commerce, RICHARD SELVAGGI, APS member — Consider the motion of photons within a rotating photon clock. Will light behave as a particle as it reflects back and forth between two parallel mirrors rotating in a manner similar to the motion of a Foucault pendulum? An experiment to measure the trajectory of light in a rotating cavity is presented. Implementation details for this experiment and initial data collected are also reported.

E9.00018 Multivariate Calibration and Maintenance Using Principle Component Selection¹, TREVOR O’LOUGHLIN, Texas Tech University, JOHN KALIVAS, PARVIZ SHAHBAZIKHAH, Idaho State University — Calibration maintenance confronts the problem of updating a model developed in primary condition to accurately predict the calibrated analyte in samples measured in new secondary conditions. Previously, the L₂ norm (TR²) variant of Tikhonov regularization (TR) have been used with spectroscopic data where a few samples measured in the secondary conditions are augmented to the primary calibration data to update the model. In this poster, the augmented data is solved by principle component regression (PCR) to determine whether selection of principle components may improve prediction errors. The measures are evaluated with a benchmark near infrared spectroscopic pharmaceutical tablet data set. It is found that principle component selection does not offer any improvements over TR.

¹Supported by NSF REU program

E9.00019 An in situ Scattering Independent Absorption and Fluorescence Meter, JESSICA CASAS, Stephen F. Austin State University — Absorption and fluorescent spectroscopy has been a useful tool for the identification of various constituents in natural waters. We extend the design of an integrated cavity absorption meter proposed by Ed Fry at TAMU, to include a fluorometer. The meter is designed to operate in situ, continuously monitoring the absorption and fluorescence of natural waters independently of scattering. This instrument could greatly extend the potential data that could be made available to oceanographers. For instance, turbid environments including post hurricane conditions or hydrocarbon plumes, such as that associated with the Deepwater Horizon event, become accessible.
E9.00020 An Aerial “Sniffer Dog” for Methane, BRIAN NATHAN, DAVE SCHAEFER, University of Texas at Dallas, MARK ZONDOLO, AMIR KHAN, Princeton University, DAVID LARY, University of Texas at Dallas — The Earth’s surface and its atmosphere maintain a “Radiation Balance.” Any factor which influences this balance is labeled as a mechanism of “Radiative Forcing” (RF). Greenhouse Gas (GHG) concentrations are among the most important forcing mechanisms. Methane, the second-most-abundant noncondensing greenhouse gas, is over 25 times more effective per molecule at radiating heat than the most abundant, Carbon Dioxide. Methane is also the principal component of Natural Gas, and gas leaks can cause explosions. Additionally, massive quantities of methane reside in the form of natural gas in underground shale basins. Recent technological advancements—specifically the combination of horizontal drilling and hydraulic fracturing—have allowed drillers access to portions of these “plays” which were previously unreachable, leading to an exponential growth in the shale gas industry. Presently, very little is known about the amount of methane which escapes into the global atmosphere from the extraction process. By using remote-controlled robotic helicopters equipped with specially developed trace gas laser sensors, we can get a 3-D profile of where and how methane is being released into the global atmosphere.

E9.00021 Simulations of Experiments on Electron Magnetohydrodynamic Reconnection in a Field Reversed Configuration, CYNTHIA CORREA, WENDEL HORTON, Institute of Fusion Studies; The University of Texas at Austin — Theory and simulations are developed to interpret laboratory electron magnetohydrodynamic reconnection experiments involving nonlinear whistlers by Stenzel et al. [R.L. Stenzel, M.C. Griskey, J. M. Urrutia, and K.D. Strohmaier, Phys. Plasmas 10, 2780 (2003)]. In that experiment, two current-carrying 30 cm antennas form a Helmholtz coil configuration and produce an elongated dipole field that opposes the uniform ambient field. The current is increased until a field-reversed-configuration with two 3D null points and a 2D null line has been established, and then the current is switched off. The EMHD dynamics are simulated with a 3D three-field nonlinear MHD code. The analytical model includes Poisson bracket nonlinearities that can give rise to vortices and coupling energy to higher modes, as well as hyperviscosity to balance the energy exchange. Simulation field topology and dynamics are compared to the laboratory experiment as verification of the simulation code. The experimental setup and other variations are simulated and examined for occurrences of driven and undriven electron magnetohydrodynamic (EMHD) reconnection.

E9.00022 Using Model Helicopters for Meteorological Observations in Support of Tornado Forecasting, WILLIAM HARRISON, BRYAN ROSCOE, DAVID SCHAEFER, University of Texas at Dallas, HOWARD BLUESTEIN, Oklahoma University, DAVID LARY, University of Texas at Dallas — In order to gain a better understanding of the physical factors involved in tornadogenesis, a complete 3-D profile of winds, temperature, and humidity in the forward-flank and rear-flank gust front regions in supercells is required. Conventional methods of making comparative measurements in and around storms are very limited. Measurements that comprehensively profile the boundary layer winds and thermodynamics are valuable but rare. A better understanding of the physical properties involved in supercells will improve forecasts and increase warning times in affected areas. Remote-controlled model helicopters are a uniquely qualified platform for this application, allowing us to fully profile these boundary layers. Our system will consist of a swarm of autonomous acrobatic helicopters, each outfitted with temperature, pressure, humidity, and wind speed sensors.

E9.00023 Coarsening of pentaerythritol tetranitrate (PETN) films as observed by absorbance spectroscopy and atomic force microscopy: a kinetic study\(^1\). WALID HIKAL, JEFFREY PADEN, MARAOUO DAVIS, BRANDON WEEKS, Texas Tech University, BRANDON L. WEEKS TEAM — Many theoretical studies have been proposed in order to understand the mechanism of PETN coarsening process. Up to date, experimental observations of surface diffusion have not been made. We present the first experimental evidence of surface diffusion of PETN as indicated by absorbance spectroscopy and atomic force microscopy (AFM) in continuous PETN nanofilms. The method is based on monitoring the change in absorbance at the center of the film as a result of the temperature gradient between the center of the film and its edges. Non-isothermal heating of the films results in an initial increased absorbance at ambient temperatures (<60°C) as an indication of thickness increase due to surface diffusion, followed by absorbance decrease due to film sublimation at relatively higher temperatures (>70°C). Isothermal heating of the PETN films at ambient temperatures (<60°C) reveals a thickness increase at all temperatures indicating a prominent surface diffusion-controlled coarsening process. Contact AFM images of the heated films show the early instantaneous appearance of PETN nanocrystals that linearly aligned to form one dimensional tetragonal PETN microcrystals at later times. Both isothermal and non-isothermal data are used to determine the coarsening kinetics of PETN.

\(^1\)This work was supported by NSF CAREER (CBET-0644832) and the Office of Naval Research under project number N00014-06-1-0922.

E9.00024 Resonant Circuit Simulation and Development for LIGO Lasers\(^1\). JOSEPH COLEMAN, The University of Texas at Dallas — The modulation of a laser, as part of a feedback mechanism, in order to control optic components for stabilization, requires the use of the electro-optic effect. To create the electric field needed for the electro-optic effect a large voltage is obtained through a Pockels cell as part of a resonant circuit. The resonant circuit functions as the voltage gain mechanism. A mathematical model of the circuit was constructed as a tool for helping to build a specifically tuned modulating circuit. Subtle features of the pi-network circuit design currently being used at LIGO were found. Additional criteria involving impedance matching is discussed. Alternative circuit designs are presented that could potentially offer better resonance conditions for the electro-optic modulator.

\(^1\)NSF REU program at The University of Texas at Brownsville.

E9.00025 Test of the Hill Stability Criterion against Chaos Indicators, SUMAN SATYAL, BILLY QUARLES, University of Texas at Arlington, TOBIAS HINSE, Korea Astronomy and Space Science Institute — The efficacy of Hill Stability (HS) criterion is tested against other known chaos indicators such as Maximum Lyapunov Exponents (MLE) and Mean Exponential Growth of Nearby Orbits (MEGNO) maps. First, orbits of four observationally verified binary star systems: \(\gamma\) Cephei, Gliese-66, HD41004, and HD196885 are integrated using standard integration packages (MERCURY, SWIFTER, NBI, C/C++). The HS which measures orbital perturbation of a planet around the primary star due to the secondary star is calculated for each system. The LEs spectra are generated to and HD196885 are integrated using standard integration packages (MERCURY, SWIFTER, NBI, C/C++). The HS which measures orbital perturbation of a planet around the primary star due to the secondary star is calculated for each system. The LEs spectra are generated to
A Computer Program to Search for Gravity Waves1, RYAN STATEN, Southwestern University — The Laser Interferometer Gravitational Wave Observatory (LIGO) project uses large scale laser interferometers in an attempt to detect gravitational waves predicted by the general theory of relativity. When a gravitational wave is incident on an arm of the interferometer, the electromagnetic waves corresponding to the laser light in the arm and the arm itself are either stretched or compressed based on the nature of the gravitational wave. This changes the wavelength of the light in the arm compared to that of the light continuing to enter the arm from the laser source, which correspondingly changes the arrival time of the returning photons (or wave fronts). I have designed a program that analyzes this, showing the expanding and contracting electromagnetic waves in an interferometer arm, and calculating the round trip travel time of the wave fronts.

Electronic structure and charge transfer excited states of a Sc₃N@C₈₀-tetraphenyl porphyrin molecular conjugate, FATEMEH AMERIKHEIRABADI, TUNNA BARUAH, RAJENDRA ZOPE, University of Texas at El Paso — Organic donor-acceptor molecular conjugates are often used as the basic component in organic solar cells. The photoexcited donor molecule donates one electron to the acceptor molecule creating a charge-transfer state. Currently a large number of different molecular complexes are being tested for their efficiency in photovoltaic devices. Such molecular conjugates are often large to describe using accurate quantum chemical methods. We have used our recently developed density functional theory based method to study the charge transfer excited states of a novel Sc₃N@C₈₀-tetraphenyl porphyrin complex. In this complex, the porphyrin is the donor and the endohedral Sc₃N@C₈₀ is the acceptor molecule. This endohedral fullerene is the third most abundant fullerene. There are few studies on such molecular complexes with endohedral fullerenes as compared to the C₆₀ molecule. We study the role of Sc₃N@C₈₀ as acceptor compared to the widely used C₆₀ molecule. Our results on the electronic structure of the complex, the Sc₃N@C₈₀ molecule in both isolation and in the complex, and the lowest charge separated states will be presented.

Photometric measurements of a Transit of Exoplanet TrES 3b1, DWIGHT RUSSELL, Department of Physics, Baylor University, Waco TX, LYDIA SHANNON, CASPER NSF-REU, Baylor University, Waco TX, RICHARD CAMPBELL, CASPER, Baylor University, Waco TX, WILLIE STRICKLAND, Meyer Observatory, Clifton TX — Using the 0.6 m Ritchey-Chretien telescope at the Paul and Jane Meyer Observatory (PJMO), light curves from a transit of exoplanet TrES 3b were produced from images made with a Roper 1300B camera. Light curves from both V and R bands will be presented. Analysis using AstroImageJ software will be discussed. Planet properties determined using the Czech Astronomical Society’s transit fitting routines will be presented.

Comparison of Neutron Star Models Using Various EOS, MICHAEL NAIZER, WILLIAM NEWTON, CARLOS BERTULANI, Texas A&M University - Commerce — In this work we discuss the solutions of the Tolman-Oppenheimer-Volkov equation for different inputs of Equation Of State (EOS). These solutions represent static models of Neutron Stars (NS). Modern EOS are used for this purpose, based on recent research on nuclear matter. The resulting NS models are compared to recent observations.

The Waste Isolation Pilot Plant1, ROBERT HAYES2, Nuclear Waste Partnership LLC — The waste isolation pilot plant (WIPP) is the worlds first licensed and operating geological repository for transuranic waste. The WIPP operation and related activities will be reviewed along with many science and development projects going on including an underground dark matter telescope and double beta decay detection experiments.

Friday, October 26, 2012 5:30PM - 6:30PM — Session G1 SPIN-UP Cracker Barrel and Informal Discussions — Holiday Inn Towers Hotel Lobby and Bar Area - Chair: Michael Marder, University of Texas at Austin

5:30PM G1.00001 Informal Discussions —

Friday, October 26, 2012 5:30PM - 6:30PM — Session G2 Special Presentation: Stories from the History of Wine — Texas Tech International Cultural Center (ICC) ICC Auditorium - Chair: Stefan Estreicher, Texas Tech University

5:30PM G2.00001 Selected Stories from the History of Wine, STEFAN ESTREICHER, Texas Tech University — The archaeological and chemical evidence of wine making shows that vines were cultivated and wine produced well over 7,000 years ago. Wine has been a part of the history of Western Civilization ever since. This talk will start with a brief overview of the key events in the history of wine, and then I will select a few topics which will be discussed in more detail. One of the topics includes a rather tenuous connection to Isaac Newton himself, a futile attempt on my part to justify the very existence of this talk at a Texas Section APS meeting.

Friday, October 26, 2012 7:00PM - 9:00PM — Session H1 Conference Banquet and After Dinner Talk — Texas Tech International Cultural Center (ICC) ICC Hall of Nations - Chair: Charles W. Myles, Texas Tech University

7:00PM H1.00001 Dinner and Awards —
9:00AM J1.00001 From the Inflationary Universe to Black Holes to Dark Energy using the Hobby-Eberly Telescope Dark Energy Experiment. KARL GEBHARDT, University of Texas at Austin — Observations over the next decade will examine the expansion history of the universe, given that we have little understanding for what drives the expansion either at late times (i.e., the nature of dark energy) or early times (i.e., inflation). I will describe an observational approach based on a large redshift survey called the Hobby-Eberly Telescope Dark Energy Experiment (HETDEX). Our goal is to understand the universe expansion, and also we will exploit the unique opportunity to study black holes and dark matter profiles in galaxies. The latest results for both the dark matter profiles and black holes show important trends that impact theories of galaxy formation and black hole growth. Thus, the inflationary universe has much to offer.

9:00AM J1.00002 Physics of Failure, MICHAEL MARDER, UT Austin — One of the questions solid state physics was long supposed to answer was why a glass shatters when you drop it on the floor but a spoon does not. It turned out not to be such an easy problem and was only occasionally addressed until a series of major accidents in the 1940’s and 1950’s directed scientific attention to it. I will talk about the basic ideas of fracture mechanics that emerged as the answer, and display some recent applications to failure of silicon, rubber, and graphene.

Saturday, October 27, 2012 9:00AM - 10:30AM —
Session K1 AAPT Workshop VII: Optics Made Easy, LESLIE RICHBURG, Plainview High School — Optics Made Easy! Whether you are teaching optics in elementary or for the high school Physics EOC, this workshop will break down the concepts for you, give you a hands on understanding of how to conduct optic labs, and brush you up on making lens calculations.

Saturday, October 27, 2012 9:00AM - 10:30AM —
Session K2 AAPT Workshop VIII: Physics of Toys, STEVEN ALEXANDER, Lamp, Texas Tech University

Saturday, October 27, 2012 9:00AM - 10:30AM —
Session L1 Atomic, Molecular, and Optical Physics II, Walter Borst, Texas Tech University

10:15AM L1.00001 Calculating Properties of Finite Mass Atoms, STEVEN ALEXANDER, Southwestern University, R.L. COLDWELL, University of Florida — Most atomic calculations assume that the mass of the nucleus is finite. If one is interested in evaluating atomic properties to high precision then this approximation cannot be made. We have developed a simple method that includes the kinetic energy of the nucleus into atomic calculations and does not increase the time or the complexity of these calculations. Our results for a variety of properties for several different atoms will illustrate some of the advantages of this method.

10:27AM L1.00002 Spectral Measurements of Low Temperature Plasma Formation at Atmospheric Pressure, GEORGE LAITY, ANDREW FIERRO, DAVID RYBERG, LYNN HATFIELD, ANDREAS NEUBER, TTU Center for Pulsed Power and Power Electronics — This paper describes the study of the emission and re-absorption of ultraviolet (UV) and vacuum ultraviolet (VUV) radiation which is produced during the initial phases of plasma formation leading to electric field breakdown at atmospheric pressures. Specifically, there is interest in understanding the photon dynamics during the streamer to spark phase transition of plasma discharges which form less than 200 ns in millimeter-sized air gaps. Fast rise-time photo-multiplier measurements reveal that the earliest VUV emission occurs in the region near the anode, with emission points following streamer positions identified by fast intensified CCD imaging with fast electronic gating (≤3 ns). Electron densities and dissociation characteristics are estimated by using measurements of the HI Lyman-α (121.5 nm) Stark-broadened line profile as a function of distance from the anode. Successive measurements in pure N2 environments show a distinct two-step transition from radiative contributions of both the N2 second positive system in the UV (300 - 400 nm) and NI atomic structure in the VUV (120 - 180 nm) during the early plasma phase, to primarily VUV emission shortly after the plasma spark has formed. The observed emission dynamics are due to a combination of N2 dissociation into NI and radiation-less quenching of the N2 molecules.

1Work supported by AFOSR, NASA/TSGC, DEPS, NDIA, and IEEE DEIS.
10:39 AM L1.00003 Entanglement of movable mirrors in a correlated emission laser
WENCHAO GE, Institute for Quantum Studies and Department of Physics, Texas A&M University, College Station, Texas 77843, USA, HYUNCHUL NHA, Texas A&M University at Qatar, Education City, P.O. Box 23874, Doha, Qatar, M. SUHAIL ZUBAIRY, Institute for Quantum Studies and Department of Physics, Texas A&M University, College Station, Texas 77843, USA — We investigate the theory of entangling two macroscopic mechanical resonators (movable mirrors) through two-mode fields generated by a correlated emission laser source inside a doubly resonant cavity. The master equations and quantum Langevin equations are studied for the atomic system and field-mirror system respectively. We show that steady state entanglement of mirrors as well as two-mode fields can be obtained in the strong field-mirror interacting regime for the input laser frequencies both tuned at the anti-Stokes sidebands. The entanglement of movable mirrors and two-mode fields can be tuned on and off by the driving field which controls the atomic system in our case. Our scheme is able to entangle two macroscopic objects with state-of-art experiment.

10:51 AM L1.00004 Comparative spectroscopic analysis of urinary calculi inhibition by Larrea Tridentata infusion and NDGA chemical extract
FELICIA MANCINI, University of Texas at El Paso — In the present comparative spectroscopic study we try to understand calcium oxalate kidney stone formation as well as its inhibition by using a traditional medicine approach with Larrea Tridentata (LT) herbal extracts and nordihydroguaiaretic acid (NDGA), which is a chemical extract of the LT bush. The samples were synthesized without and with LT or NDGA using a simplified single diffusion gel growth technique. While the use of infusion from LT decreases the sizes of calcium oxalate crystals and also changes their structure from monohydrate for pure crystals to dihydrate for crystals grown with different amounts of inhibitor, both Raman and infrared absorption spectroscopic techniques, which are the methods of analysis employed in this work, reveal that NDGA is not responsible for the change in the morphology of calcium oxalate crystals and does not contribute significantly to the inhibition process. The presence of NDGA slightly affects the structure of the crystals by modifying the strength of the C=C bonds as seen in the Raman data. Also, the current infrared absorption results demonstrate the presence of NDGA in the samples through a vibrational line that corresponds to the double bond between carbon atoms of the ester group of NDGA.

11:03 AM L1.00005 Sub-Wavelength Lithography Using Nitrogen-Vacancy Color Centers in diamond
FAHAD ALGHANNAM, Institute for Quantum Studies and Department of Physics and Astronomy, Texas A&M University, College Station, Texas 77843-4242, USA, PHILIP HEMMER, Department of Electrical and Computer Engineering, Texas A&M University, College Station, TX 77843-4242, USA, ZEYANG LIAO, Institute for Quantum Studies and Department of Physics and Astronomy, Texas A&M University, College Station, TX 77843-4242, USA, MOHAMMAD AL-AMRI, the National Center for Mathematics and Physics, KACST, P.O. Box 6086, Riyadh 11442, Saudi Arabia, M. SUHAIL ZUBAIRY, Institute for Quantum Studies and Department of Physics and Astronomy, Texas A&M University, College Station, Texas 77843-4242, USA — In classical optical lithography, resolution is limited to about half of the wavelength of the source used in the process. However, as we reach high frequencies (Deep UV or X-ray), several problems and difficulties occur. Over the last decade, several techniques were suggested to go beyond the classical limit. In 2010, Liao, Alamri, and Zubairy proposed a method using two lasers with different frequencies; one is used to induce Rabi oscillations between two states and the other is used to excite the ground state to a third state, thus writing the lithography pattern. In this presentation I will talk about an experimental approach to implement their method of sub-wavelength lithography using optical and magnetic properties of NV color centers in diamond.

11:15 AM L1.00006 Quantum interference due to energy shifts and its effect on spontaneous emission
ZHENG-HONG LI, Institute for Quantum Science and Engineering (IQSE) and Department of Physics and Astronomy, Texas A&M University, College Station, TX 77843-4242, USA, LES SHEFFIELD, Mathematics at the University of Texas at Dallas, M. SUHAIL ZUBAIRY, Institute for Quantum Science and Engineering (IQSE) and Department of Physics and Astronomy, Texas A&M University, College Station, Texas 77843-4242, USA, WENCHAO GE, Institute for Quantum Studies and Department of Physics, Texas A&M University, College Station, Texas 77843, USA — We investigate the theory of quantum interferes resulting from the energy shifts having significant influence on the effective decay rates of the two levels, even when the transition dipole elements are the same and the energy separation of the two levels is small. We also show that the energy shift has substantial influence on the spectrum emitted by the atom. The result is valid in the long time limit. The effect of the energy shift can be observed at the time scale of one over the atomic decay rate.

11:27 AM L1.00007 Using a Microwave Resonant Cavity to Study Hydrogen Bonding at Phase Transition in H2O and D2O
JIM ROBERTS, University of North Texas, JAI DAHIYA, S. GHOSH TEAM — The resonant microwave cavity is a very sensitive device for detecting small changes in material properties as they are perturbed by temperature, electric and magnetic fields. In this laboratory all states of matter have studied with the resonant cavity, including the plasma state. In this paper we report on an experiment with water as it changes from liquid (disordered) to water ice (ordered) phase. In that hydrogen bonds are involved in this process, we are able to observe their behavior through the dielectric response of H2O as it is cycled from solid to liquid. The transition through the densest state of water near 4°C indicates that the structure of the water molecules in the ice phase at 0°C is less compact than that at the most dense temperature of water. If we associate this density with the interaction of the hydrogen bonds, it can be postulated that the distribution of the structure in snowflakes is a consequence of random processes in sharing the hydrogen bonds as the system cycles from the “disordered” state to the more ordered state. In this work phase transition from liquid to solid and solid to liquid was studied for H2O and D2O. It was assumed that the bonding of the two molecules is the same during the transition from ordered to disordered states and in the reverse transition for disordered to ordered states. The apparatus employed in this investigation is discussed briefly.

11:39 AM L1.00008 Pulsed rotating supersonic source for merged molecular beams
LES SHEFFIELD, MARK HICKEY, VITALIY KRASOVITSKY, DAYA RATHNAYAKA, IGOR LYUKSYUTOV, DUDLEY HERSCHBACH, Texas A&M University — We continue the characterization of a pulsed rotating supersonic beam source. The original device was described by M. Gupta and D. Herschbach, J. Phys. Chem. A 105, 1626 (2001). The beam emerges from a nozzle near the tip of a hollow rotor which can be spun at high-speed to shift the molecular velocity distribution downward or upward over a wide range. Here we consider mostly the slowing mode. Introducing a pulsed gas inlet system, and a shutter gate eliminate the main handicap of the original device in which continuous gas flow imposed high background pressure. The new version provides intense pulses, of duration 0.1–0.6 ms (depending on rotor speed) and containing ~10^{12} molecules at lab speeds as low as 35 m/s and ~10^{15} molecules at 400 m/s. Beams of any molecule available as a gas can be slowed (or speeded); e.g., we have produced slow and fast beams of rare gases, O2, NO2, NH3, and SF6. For collision experiments, the ability to scan the beam speed by merely adjusting the rotor is especially advantageous when using two merged beams. By closely matching the beam speeds, very low relative collision energies can be attained without making either beam very slow.
coherence, enables us to break detailed balance and get more power out of a laser or photocell. In principle, a quantum limit to photovoltaic operation can exceed the classical one, so that noise-induced quantum coherence, such as Fano interference, can break detailed balance and yield lasing without inversion. It is claimed that it is possible to break detailed balance via quantum coherence, as in the case of lasing without inversion and the photo-Carnot quantum heat engine. Although in complete accord with the laws of thermodynamics, in principle, a quantum limit to photovoltaic operation can exceed the classical one, so that noise-induced quantum coherence, such as Fano interference, can break detailed balance and get more power out of a laser or photocell.

10:15AM L2.00001 The variations of geomagnetic energy and solar irradiance and their impacts on Earth’s upper atmosphere. PHILIP VETTER, Princeton University, Texas A&M University. In quantum heat engines, incident light excites electrons, which can then deliver useful work to a load. Radiatively induced quantum coherence can break detailed balance and yield lasing without inversion. It is claimed that it is possible to break detailed balance via quantum coherence, as in the case of lasing without inversion and the photo-Carnot quantum heat engine. Although in complete accord with the laws of thermodynamics, in principle, a quantum limit to photovoltaic operation can exceed the classical one, so that noise-induced quantum coherence, such as Fano interference, can break detailed balance and get more power out of a laser or photocell.

10:15AM L2.00002 Cosmology in One-dimension: Evolution of correlation and Fractal Void Geometry. BRUCE MILLER, Texas Christian University, JEAN-LOUIS ROUET, Universite d’Orleans. Concentrations of matter in the universe, such as galaxies and galactic clusters, originated as very small density fluctuations in the early universe. The existence of galaxy clusters and super-clusters suggests that a natural scale for the matter distribution may not exist. A point of controversy is whether the distribution is fractal and, if so, over what range of scales. Even with recent astronomical surveys and simulations, it is difficult to extract information concerning fractal properties with confidence. With one-dimensional models we can overcome these limitations by carrying out simulations with on the order of a quarter of a million particles. They clearly demonstrate that the important dynamics for cluster formation occurs in the position-velocity plane. Here we present the recent results of our on-going study of the fractal geometry of one dimensional models of the expanding universe. The evolution of the power spectra and correlation function will be followed and their relation to the correlation dimension will be explored. An improved approach for determining the fractal dimensions of low density regions (voids) will be presented.

10:45AM L2.00003 Growth of Structure in the Szkerezes Inhomogeneous Cosmological Models and the Matter-Dominated Era. AUSTIN PEEL, MUSTAPHA ISHAK, Univ of Texas, Dallas. Observations reveal that the universe is not truly homogeneous—large voids and galaxy superclusters can occupy significant fractions of the observable universe. Light that reaches us travels through and is influenced by these inhomogeneous structures. As cosmological data become ever more precise, it is important to explore frameworks that relax the usual assumptions of perfect homogeneity and isotropy to determine how inhomogeneities might affect our interpretation of observations. As a step toward this, we study large-scale structure growth in the Szkerezes inhomogeneous cosmological models. The Szkerezes metric is an exact solution of Einstein’s field equations with an irrotational dust source that in general has no symmetries. We use the Goode and Wainwright formulation of the models, which can be considered as exact perturbations of some associated Friedmann-Lemaître-Robertson-Walker (FLRW) background, and identify a density contrast that we evolve through the matter-dominated era. The equation for the density contrast turns out to contain the usual linearly perturbed FLRW terms plus two nonlinear terms. We find that the Szkerezes growth rate is stronger than the linearly perturbed FLRW approach by up to a factor of five, reflecting the exact Szkerezes nonlinear effects.

11:09AM L2.00004 Testing GR and Studying Dark Matter in the Aftermath of Galaxy Clusters Colliding. LINDSAY KING, University of Texas at Dallas, HELEN RUSSELL, University of Waterloo, Canada, REBECCA CANNING, Stanford University, DOUGLAS CLOWE, Ohio University. Astrophysical observations are consistent with most of the universe being dark: dark matter—predominantly cold—and dark energy. Unlike normal baryonic matter that we see directly, these dark components are studied via their impact on the dynamics and geometry of the universe, and on the growth of massive structures. Galaxy clusters are the most massive bound objects in the universe. Most of their normal matter is in the form of hot gas that emits X-rays. Seeing clusters after they have violently merged is very rare, but such systems are critical in testing gravity and general relativity on large scales, and in refining our understanding of dark matter. Dark matter and hot gas behave differently during a merger, with the hot gas becoming retarded and separated from the dominant dark matter. I discuss the importance of these systems, and outline how their strong and weak gravitational lensing signatures are used to map their mass—indeed of it being luminous or dark. This map is compared with the distribution of the hot gas revealed by X-ray telescopes. Then I describe our current work on a unique galaxy cluster merger system.
11:21AM L2.00005 Self-Calibration Techniques for 3-point Intrinsic Correlations in Weak Gravitational Lensing Surveys¹, MICHAEL TROXEL, MUSTAPHA ISHAK, Univ. of Texas at Dallas — The weak lensing signal (cosmic shear) has been shown to be contaminated by correlations between the intrinsic alignment (IA) of galaxies, which poses a barrier to precision weak lensing measurements in planned surveys. We review recent work to extend the self-calibration approach to the cosmic shear bispectrum. The self-calibration techniques use the redshift separation dependencies of the IA bispectra and the non-linear galaxy bias in order to isolate and remove the impact of the IA correlations on the cosmic shear signal. We outline the proposed self-calibration techniques for the 3-point cosmic shear auto- and cross-correlations and summarize their performance. Using conservative estimates of photometric redshift error, we find that planned surveys will be able to measure the IA redshift separation dependence over ranges of \(|\Delta z|/z < 0.2\) in the 3-point ellipticity auto-correlation. For the 3-point cross-correlations, we find that the self-calibration technique allows for reductions in the IA contamination by a factor of 10 or more over most scales and redshift bin choices and in all cases by a factor of 3-5 or more. The 3-point self-calibration techniques thus provide a means to greatly reduce the impact of IA on the cosmic shear signal.

1Supported in part by grants from NSF (AST-1109667) and NASA (NNX09AJ55G) and by a NASA/TSGC Graduate Fellowship.

11:33AM L2.00006 Big Bang Nucleosynthesis with a non-Maxwellian distribution, JOHN FUQUA, CARLOS BERTULANI, Texas A&M University-Commerce, M.S. HUSSEIN, Universidade de Sao Paulo — The cosmological big bang model is in agreement with many observations relevant for our understanding of the universe. However, comparison of calculations based on the model with observations is not straightforward because the data are subject to poorly known evolutionary effects and systematic errors. Nonetheless, the model is believed to be the only probe of physics in the early universe during the interval from 3-20 minutes, after which the temperature and density of the universe fell below that which is required for nuclear fusion and prevented elements heavier than beryllium from being formed. Here we consider primordial nucleosynthesis predictions with modified (Tsallis) statistics regarding the velocity or energy distribution of nucleons and nuclei.

11:45AM L2.00007 Variable Star Search Using ROTSE3 Data, FARLEY FERRANTE, ROBERT KEHOE, Southern Methodist University — I present results of a variable star search using data from the Robotic Optical Transient Search Experiment 3 (ROTSE3) telescopes. Variable stars fluctuate in magnitude as seen from Earth due either to changes in the star’s luminosity or to changes in the amount of the star’s light that reaches Earth. My research is focused on analysis of the time variation of optical light output as recorded in ROTSE images. Specifically, I am attempting to identify short-period variable candidates such as delta Scuti stars, eclipsing binary stars, and contact binary stars. Amplitude variations for these classes of variables are on the order of one magnitude with periods typically short. The objective of the search is to extend the range of objects than previous searches and I will report on the confirmed discovery of a previously unidentified contact binary star in the constellation Sagittarius. This search is currently in its first year of operation at the VISTA observatory.

Saturday, October 27, 2012 10:15AM - 12:13PM
Session L3 Invited and Contributed Papers on Physics Education Research

10:15AM L3.00001 Implementation of Math Pre-testing and Tutorials for Improving Student Success in Algebra-based Introductory Physics Course, DONNA STOKES, University of Houston — The student success rate in the algebra-based Introductory General Physics I course at the University of Houston (UH) and across the United States is low in comparison to success rates in other service courses. In order to improve student success rates, we have implemented, in addition to interactive teaching techniques, pre-testing as an early intervention process to identify and remediate at-risk students. The pre-tests include a math and problem-solving skills diagnostic exam and pre-tests administered prior to all regular exams. Students identified as at risk based on their scores on these pre-tests are given incentives to utilize a tutoring intervention consisting of on-line math tutoring to address student deficiencies and tutoring by graduate Physics Teaching Assistants to address student understanding of the physics concepts. Results from 503 students enrolled in three sections of the course showed that 78% of the students identified as at-risk students by the diagnostic exam who completed the math tutorial successfully completed the course, as compared to 45% of at-risk students who did not complete the math tutorial. Results of the pre-testing before each regular exam showed that all students who were identified as at risk based on pre-test scores had positive gains ranging from 9 – 32% for the three regular exams. However, the large standard deviations of these gains indicate that they are not statistically significant; therefore, pretesting before exams will not be offer in the course. However, utilization of the math tutorials as remediation will continue to be offered to all sections of the algebra-based course at UH with the goal of significantly improving the overall success rates for the introductory physics courses.

10:50AM L3.00002 Lessons From a Large-Scale Assessment Project at Texas Tech¹, BETH THACKER, Texas Tech University — Some results of a large-scale assessment project at Texas Tech University will be discussed. We will discuss (1) the use of both pre- and post-tests as a measure of students’ understanding in the introductory courses, (2) the efficacy of multiple choice assessment, based on research on the effect of problem format on students’ answers and (3) the need for the development of a more comprehensive assessment instrument(s) that could be used to compare students’ analytical, quantitative, computational, laboratory, and critical thinking skills, as well as their conceptual understanding, across courses and universities. We present results of the work done at Texas Tech University and discuss work being done nationally as part of the American Association of Physics Teachers (AAPT) to move towards a more comprehensive assessment of our introductory courses.

¹This work is supported by National Institutes of Health (NIH) Grant 5RC1GM090897-02 and National Science Foundation (NSF) Grant 0737181.

11:21AM L3.00003 Nesting in Graphical Representations in Physics, HUNTER CLOSE, ELEANOR CLOSE, DAVID DONNELLY, Texas State University-San Marcos — We develop a theoretical model for understanding one way, “nesting,” that space is used in graphics from within and outside physics. Nesting can be used to increase a graphic’s capacity for displaying several dimensions of information, beyond the two dimensions afforded by a flat page. We use the model of nesting to analyze previously observed student difficulties with electromagnetic waves, to predict how physics students would interact with certain graphics, and to generate new multivariate graphics in physics for instruction and for research on student thinking. Finally we apply the nesting model to explain the multidimensionality of certain kinds of gestures in physics education.
in different sections of the same course will also be discussed. Changes in the period between the two courses, but more data is needed to confirm this. Variations in attitude shifts for individual instructors in different sections of the same course will also be discussed.

11:49AM L3.00005 Understanding the Learning Assistant experience with Physics Identity and Community of Practice. ELEANOR CLOSE, HUNTER CLOSE, DAVID DONNELLY, Texas State University-San Marcos — Learning Assistants (LAs) have been shown to have better conceptual understanding and more favorable beliefs about science than non-LAs, and are more likely to choose a career in K-12 science teaching [1]. We propose that connections between elements of identity, persistence, and participation in an LA program can be explained using the concept of the community of practice and its intimate relationship to identity [2]. In separate work, Hazari et al. found that physics identity was highly correlated to expressed career plans in physics [3]. We hypothesize that a thriving LA program has many features of a well-functioning community of practice and contributes to all four elements of physics identity: personal interest, student performance, competence, and recognition by others. We explore how this analysis of the LA experience might shape decisions and influence outcomes of adoption and adaptations of the LA model.


12:01PM L3.00006 Effectiveness of Workshop Style Teaching in Students’ Learning of Introductory Electricity and Magnetism. NIRAV MEHTA, Trinity University, KELVIN CHENG, Texas Tech University — We have developed an interactive workshop-style course for our introductory calculus-based physics sequence at Trinity University. Lecture is limited to approximately 15 min. at the beginning of class, and the remainder of the 50-min. class is devoted to inquiry-based activities and problem solving. So far, lab is done separately and we have not incorporated the lab component into the workshop model. We use the Brief Electricity and Magnetism Assessment (BEMA) to compare learning gains between the workshop and traditional lecture-based course for the Spring 2012 semester. Both the workshop and lecture courses shared the same inquiry-based lab component that involved pre-labs, prediction-observation and post-lab activities. Our BEMA results indicate statistically significant improvement in overall learning gains compared to the traditional course. We compare our workshop BEMA scores both to traditional lecture scores here at Trinity and to those from other institutions.


10:15AM L4.00001 Characterization and Optimization Multiscale and Multicomponent Nanosystems. KELLY NASH, University of Texas at San Antonio — Materials with new combinations of properties are increasingly needed to meet the requirements of energy, transportation, and medical applications. The use of multi-component systems, with potentially complementary properties, represent a unique path to improve materials properties for a variety of applications. Among the most interesting applications of these materials is in the development of contrast agents in biological imaging and dynamic sensing applications. Although a variety of techniques to characterize these materials exist, noninvasive characterization methods, such as optical-based techniques, are ideal for studying these materials in their native state and for monitoring dynamic changes. The proposition becomes even more attractive when at least one of the components carries an optical signature. The use of optoacoustic (OA) is an emerging technology based on studying optically absorbing nano and microstructures in the sample by recording transit pressure waves generated from laser-induced thermal expansion. More recently OA has been developed as a vibrant technology for medical applications and some growing applications is for material characterization in research and industrial applications. Specifically, OA can assist in the characterization and optimization of composite materials containing nanoparticles when paired with other characterization techniques. The present work illustrates an overview of select hybrid nanomaterials, including their unique optoacoustic signatures utilizing an all optical OA technique. The results of this work show that optical based techniques such as OA, provide a noninvasive, nondestructive means to study multi-material, multi-scale, multi-functional materials are important in the development of novel multi-component nanomaterial schemes and elucidating the structure-function relationship in these materials.

1This work is partly supported by the National Science Foundation Partnerships for Research and Education in Materials (PREM) Grant No. DMR-0934218 and the UTSA-SwRI Connect Program.

10:50AM L4.00002 Characterization of Au/Rare Earth Oxide/Au Thin-films by all Optical Photoacoustic Spectroscopy. ZANNATUL YASMIN, NATHAN RAY, EDWARD KHACHATRYAN, Physics and Astronomy; University of Texas at San Antonio, SAEGER MASWADI, RANDOLPH GLICKMAN, Ophthalmology, University of Texas Health Science Center-San Antonio, KELLY NASH, Physics and Astronomy, University of Texas at San Antonio — Photoacoustic spectroscopy (PAS) is a sensitive spectroscopy based on transit pressure waves generated from laser-induced thermal expansion in absorbing medium. Over the last decade the technique has shown promise for sensing, imaging and detection in biological applications especially when using nanoparticles. The nanoscale interaction of functionalized nanoparticles (FNPs) has attracted interest due to their potential applications in biosensors and biomedical diagnostics. In particular, gold nanoparticles have been used as contrast agents for signal enhancement and time-intensity curve measurements. Moreover, rare earth ion doped rare earth metal oxide (REMO) exhibits multi-wavelength absorbance and emission that overlap well with the surface plasmon resonance of FNPs. In this work, we are characterizing gold attached Er3+ doped Y2O3 coated by silanation as a thin film formed on a glass substrate by use of an all optical PAS technique. We expect that, this PAS technique will provide unique information about the interaction of the FNPs and REMO and use as sensors in the biological systems without the artifacts limiting the use of current methods, such as fluorescent indicators.

1The National Science Foundation Partnerships for Research and Education in Materials (NSF-PREM) Grant No. DMR -0934218.
11:02AM L4.00003 Heat Flow in Heterostructures, MEHMET BEBEK, STEFAN ESTREICHER, Texas Tech University — Existing theoretical descriptions of thermal transport through heterostructures describe the process in terms of empirical reflection and transmission. First-principles theoretical tools are required to describe at the atomic level the flow of heat at the boundary between two materials. The interactions between the (localized) phonons associated with the interface and the (delocalized) bulk phonons can be described using ab-initio molecular-dynamics simulations provided that temperature fluctuations are controlled without using a thermostat. This potential can be achieved by preparing the heterostructure using the eigenvectors of the dynamical matrix. Our approach and preliminary results dealing with a Ge layer in a Si nanowire will be discussed.

11:14AM L4.00004 Optical properties of hierarchical architectures of YBO₃:Eu³⁺ phosphor, SANDEEP SOHAL, Department of Physics, Texas Tech University, Lubbock, TX, XIANWEN ZHANG, ARCHIS MARATHE, JHARNA CHAUDHURI, Department of Mechanical Engineering, Texas Tech University, Lubbock, TX, MARAUCO DAVIS, LOUISA J. HOPE-WEEKS, Department of Chemistry & Biochemistry, Texas Tech University, Lubbock, TX, MARK HOLTZ, Department of Physics, Texas Tech University, Lubbock, TX — We investigated nano- and micro-structures of YBO₃:Eu³⁺ phosphor synthesized using a hydrothermal approach for white light emission applications. Optical properties using photoluminescence (PL) technique were examined under different excitation wavelengths, ranging from the deep to near ultraviolet. Single crystal nanoflakes gathered together to evolve into a hierarchical architecture through self-assembly processes with eight different three dimensional morphologies. The samples show narrow-line width orange (O) and red (R) PL at 592, 611, 627 nm at all excitation wavelengths. The PL originates from ^5D⁰−^7F₂ (J = 1, 2, 3, 4) transition levels of Eu³⁺. YBO₃:Eu³⁺ prepared using ethanol solvent has the highest R/O ratio with chromaticity coordinates (0.64, 0.33) in Commission Internationale de l’Eclairage (CIE) diagram. We observed that the R/O ratio increases as we go from deep to near ultraviolet excitation, indicating that different luminescence centers of Eu³⁺ exist in YBO₃ in samples.

11:26AM L4.00005 Theoretical Study of the Structural and Electronic Properties of KₓSi₁₃₋ₓ, (x = 1, 8, 18), CRAIG HIGGINS, CHARLES MYLES, Texas Tech University, TEXAS TECH TEAM — Type II clathrate semiconductors have cage-like lattices in which Group IV atoms are tetrahedrally-coordinated and sp³ covalently bonded. The cages can contain “guest” atoms; usually alkali or alkaline earth atoms. These materials are of interest because of their thermoelectric properties. Measurements of the lattice constant [¹] as a function of Na concentration x in NaₓSi₁₃₋ₓ (0 ≤ x ≤ 24) have shown the interesting property that, as x is increased in the range (0 ≤ x ≤ 8), the lattice constant decreases and that as x is increased further in the range (8 ≤ x ≤ 24), the lattice constant increases. We note that some measurements of the properties of KₓSi₂₃₋ₓ have also recently been reported [²]. These observations have motivated us to study the behavior of the lattice constant and other properties as a function of guest concentration in other Type II clathrate. In the present paper, we report the results of a theoretical study of the properties of KₓSi₁₃₋ₓ as a function of x. We have used density functional theory to investigate the properties of this material with guest concentrations of x = 1, 8, and 18. Our results show that, similar to previous results for NaₓSi₁₃₋ₓ, the lattice constant as a function of x has a minimum at x = 8. We also report results for other structural and electronic properties of KₓSi₁₃₋ₓ.


11:38AM L4.00006 Theoretical Study of the Properties of the Type II Clathrate AₓSn₁₃₋ₓ, (A = alkali atom; 0 ≤ x ≤ 24), DONG XUE, CRAIG HIGGINS, CHARLEY MYLES, Texas Tech University — Motivated by recent experimental and theoretical interest in the x dependence of the properties of the Si and Ge-based Type II clathrate materials AₓSi₁₃₋ₓ and AₓGe₁₃₋ₓ (A = alkali atom) [¹,²] we are carrying out a systematic theoretical study of the properties of the Sn-based Type II clathrate system AₓSn₁₃₋ₓ. Type II clathrates have cage-like lattices in which Si, Ge, or Sn atoms are tetrahedrally-coordinated and sp³ covalently bonded. The cages can contain “guests”; usually alkali or alkaline earth atoms. These materials are particularly interesting because of their potential use as thermoelectrics. Recent powder x-ray diffraction experiments have found the very interesting result that, for increasing x in the range 0 ≤ x ≤ 8 a lattice contraction occurs, and that x is increased further (8 ≤ x ≤ 24), a contrasting lattice expansion results. These observations have motivated us to study the behavior of the lattice constant and other properties as a function of guest concentration in other Type II clathrates. In the present paper, we report preliminary results of a density functional based theoretical study of the properties of KₓSn₁₃₋ₓ as a function of x. We present results for the x dependence of the lattice constant as well as for other structural and electronic properties of this material.


11:50AM L4.00007 Advantages and Uses of AMTEC, M.A.K. LODHI, Texas Tech University — Static conversion systems are gaining importance in recent times because of newer applications of electricity like in spacecraft, hybrid-electric vehicles, military uses and domestic purposes. Of the many new static energy conversion systems that are being considered, one is the Alkaline Metal Thermal Electric Converter (AMTEC). It is a thermally regenerative, electrochemical device for the direct conversion of heat to electrical power. As the name suggests, this system uses an alkali metal in its process. The electrochemical process involved in the working of AMTEC is ionization of alkali metal atoms at the interface of electrode and electrolyte. The electrons produced as a result flow through the external load thus doing work, and finally recombine with the metal ions at the X-ray diffraction experiments. AMTECs convert the work done during the nearly isothermal expansion of metal vapor to produce a high current and low voltage electron flow. Due to its principle of working it has many inherent advantages over other conventional generators. These will be discussed briefly.

12:02PM L4.00008 Pressure Induce Phonon Instabilities in BCC Tantalum Single crystals, OSCAR GUERRERO, UTSA — Large-scale atomistic simulations of shock-wave propagation in single crystals exhibit large anisotropies in the elastic-plastic and solid-liquid transitions. Characteristic of this type of simulations are the large strains at which the crystal yields plastically, regardless of crystal orientation. At these large strains, uniaxial deformations, such as those produced in planar shock loading generate phonon instabilities. Using non equilibrium molecular dynamics simulation (NEMD), We have investigated the directional anisotropy of the elastic limit in body-centered-cubic Tantalum (bcc) crystals, under quasi-isotropic compression, and using the embedded atom method (EAM) to model the atomic interactions. We show that the elastic-plastic transition in BCC defect-free crystals is caused by the appearance of soft-phonon modes and not via homogenous nucleation of extended defects.
12:14PM L4.00009 Structural and electronic properties of high pressure phases of lead chalcogenides, JOHN PETERSEN, LUIJSA SCOLFARO, THOMAS MYERS, Texas State University — Lead chalcogenides, most notably PbTe and PbSe, have become an active area of research due to their thermoelectric properties. The high figure of merit (ZT) of these materials has brought much attention to them, due to their ability to convert waste heat into electricity. Variation in synthesis conditions gives rise to a need for analysis of structural and thermoelectric properties of these materials at different pressures. In addition to the NaCl structure at ambient conditions, lead chalcogenides have a dynamic orthorhombic (Pnma) intermediate phase and a higher pressure yet stable CsCl phase. By altering the lattice constant, we simulate the application of external pressure; this has notable effects on ground state total energy, band gap, and structural phase. Using the General Gradient Approximation (GGA) in Density Functional Theory (DFT), we calculate the phase transition pressures by finding the differences in enthalpy from total energy calculations. For each phase, elastic constants, bulk modulus, shear modulus, Young’s modulus, and hardness are calculated, using two different approaches. In addition to structural properties, we analyze the band structure and density of states at varying pressures, paying special note to thermoelectric implications.

12:26PM L4.00010 Positron Annihilation Spectroscopy of Barnett Shale Core Samples, HAYDEN MORGAN, MILTON ENDERLIN, C.A. QUARLES, TCU — Positron annihilation spectroscopy (PAS) is an experimental technique that provides information about the internal structure of an object, specifically the porous spaces or defects that are present within the object. The lifetime of a positron within the sample is measured, which depends upon the volume of the space the positron becomes “trapped” in. While PAS has been applied to geological samples in the past, the present project focuses on Barnett Shale core, which has not been studied extensively with PAS. PAS presents a unique opportunity to learn about the micro-pores within the shale. These micro-pores are of critical importance because they contain natural gas, oil, and other organic compounds. Our project has 3 main goals: to determine the average positron lifetimes of a shale sample, to investigate the uniformity of shale core, and to observe the effect on the internal structure of shale after a handheld micro-conical indentation test, known as a “dimple test,” has been performed. This dimple test is an application of a small, concentrated force onto the shale, which subsequently fractures the shale (within a small radius around the impact point). Our preliminary results conclude that shale is relatively non-uniform, and that the volume of the micro-pores within the shale sample is significantly affected by the dimple test.

12:38PM L4.00011 Photoluminescence Investigation of Oxidation on GaN, GULTEN KARAOGLAN, VLADIMIR KURYATKOV, SERGEY NIKISHIN, MARK HOLTZ, TTU, MARY M. COAN, DEREK W. JOHNSON, JUNG HWAN WOO, IMAN REZANEZHAD, H. RUSTY HARRIS, TAMU, MARK HOLTZ’S GROUP AT TTU TEAM, RUSTY HARRIS’S GROUP AT TAMU TEAM — We investigated the effect of oxide layers grown on GaN/sapphire using thermal oxidation and atomic layer deposition (ALD) for MOS-HEMT applications by means of photoluminescence (PL) measurements. Any influence from the oxide is expected to be at the topmost GaN layer (< 100 nm) so optical measurements are performed to probe the effect of oxide. For the thermal oxide, PL spectra were measured (10 K) prior to oxidation, with oxide, and following removal. The primary PL peak blue shifts 7 meV after the oxidation, but returns to the original position upon the removal of oxide. This shift is attributed to stress from the oxide. Below-bandgap emission is observed upon oxidation; these features remain after removing of the oxide. PL for ALD HfO2/GaN and Al2O3/GaN samples exhibit only minor shift for the primary PL peak. Weak sub-bandgap PL peaks may be attributed to native defects and donor-acceptor recombination. A band near 3.27 eV for samples with oxide may suggest that oxygen impurities are involved in the recombination process.