Joint Fall 2010 Meeting of the Texas Sections of the APS, AAPT, Zone 13 of SPS and the National Society of Hispanic Physicists
San Antonio, Texas
http://www.aps.org/meetings/meeting.cfm?name=TSF10
Friday, October 22, 2010 8:15AM - 9:42AM –
Session FI1 Opening Remarks and Invited Session I University Center III Ballroom I, 1st floor -
M. Yacaman, University of Texas at San Antonio

8:15AM FI1.00001 OPENING REMARKS JOHN FREDRICK, Provost of the University of Texas at San Antonio —

8:30AM FI1.00002 Towards a Model of Cold Denaturation of Proteins, ISAAC SANCHEZ, University of Texas at Austin — Proteins/enzymes can undergo cold denaturation or cold denaturation. In the active or natural state, a protein exists in a unique folded/ordered state. In the deactivated (denatured) state, a protein unfolds and exists in a disordered expanded state. This protein folding/unfolding or order/disorder transition can be triggered by a temperature change. What seems paradoxical is that the active (ordered) state can be induced by heating, or equivalently, the disordered inactive state can be induced by cooling. This is equivalent to an Ising spin model passing from a disordered array of spins to an ordered array by increasing temperature! Hydrogels and their corresponding polyelectrolyte chains behave similarly, i.e., the swollen disordered state can be induced by cooling while the more ordered collapsed or globular state is induced by heating (an entropically driven phase transition). In a living cell at the physiological temperature of 37 C, activation and deactivation of proteins is triggered by local environmental changes in pH, salinity, etc. The important physics is that the denaturation temperature can be moved up or down relative to 37 C by these stimuli. Moving the transition temperature up can destabilize the active protein while moving it down leads to stabilization. An analytical polymer model will be described that exhibits cold denaturation behavior.

9:06AM FI1.00003 Milestoning: A rigorous coarse graining method for simulating properties of biological molecules1. RON ELBER, University of Texas — Milestoning is a method for calculating kinetics and thermodynamics of long time processes typically not accessible for straightforward Molecular Dynamics (MD) simulation. In the Milestoning approach, the system of interest is partitioned into cells by dividing hypersurfaces (Milestones) and transitions are computed between nearby hypersurfaces. Kinetics and thermodynamics are derived from the statistics of these local transitions. We describe an extension to the original Milestoning that we called Directional Milestoning. It avoids the use of a reaction coordinate, provides exact first hitting distribution at the interfaces, and supports sufficiently long relaxation time between the interfaces for better accuracy. I will describe the adjusted theory and algorithm, and will present results on a model system alanine dipeptide and for the folding of the helical peptide WAAAH. Interestingly the kinetic of folding of WAAAH shows significant co-operativity and is close to an all or none transition. The calculations are consistent with experimental measurements of kinetic, thermodynamic, and structure of this peptide.

1Supported by NIH grant GM059796.

Friday, October 22, 2010 10:00AM - 11:36AM –
Session FM1 Atomic, Molecular, and Optical Physics I University Center III Travis Room, 2nd floor - Harry Downing, Stephen F. Austin State University

10:00AM FM1.00001 Effect of Pulse Shaping on Electromagnetic Induced Transparency and its Applications1, DONG SUN, SUMANTA DAS, Department of Physics, Texas A&M University, ZOE-ELIZABETH SARIYANNI, JILA, University of Colorado, YURI ROSTOV'TSEV, Department of Physics, University of North Texas — We have theoretically studied the effect of pulse shapes on Electromagnetic Induced Transparency (EIT) and the propagation of pulses inside EIT medium. Our numerical simulations are based on an isotropic homogeneous medium composed of 3-level A type atoms coupled to two co-propagating laser fields. It has been found that even with the two-photon resonance, if these two fields have unmatched pulse shapes, there is still no EIT. The mechanism is explained in the dressed state, in which a pulse shape dependent interaction is found. We also observed the nonlinear effect of EIT on pulse propagation inside medium by using Fourier Analysis. Some possible applications are proposed.

1This work is supported by Robert A. Welch Foundation.

10:12AM FM1.00002 Evaluating Entanglement in Stern-Gerlach Dynamics, JEAN-FRANCOIS S. VAN HUELE, Brigham Young University, BAILEY C. HSU, National Chiao Tung University, Hsinchu 30010, Taiwan — The Stern-Gerlach experiment that revealed the reality of space quantization in 1922 is also an exemplary model for entanglement between space and spin. Based on the result of analytical and numerical dynamical Stern-Gerlach calculations, we search for a representative measure of space-spin entanglement. We compare different entanglement measures that have been proposed and apply some of them to the dynamics of spin separation in a beam of neutral particles traversing inhomogeneous magnetic fields.

10:24AM FM1.00003 Testing Ionizers for Nitrogen Discharge of Interferometer Optics1, TIMOTHY AMEN, DENNIS UGOLINI, Trinity University — Interferometric gravitational-wave observatories consist of suspended optics in a vacuum chamber. Charge can build up on and then discontinuously jump across an optic, creating a changing electric field, causing the optic to sway, creating a false signal. We studied possible ways to discharge an optic without damaging their reflective coatings. We tried two types of electron guns. The first was built at the University of Washington and uses an ultraviolet LED to free electrons from a magnesium target. We found the current to be three orders of magnitude less than necessary for discharge in a reasonable time. The second gun used was a Bayard-Alpert gauge. To eliminate sputtering caused by the gauge above 10^{-4} torr, we employed a differential pumping system. We were able to flow nitrogen gas through the main chamber at pressures between 10^{-2} and 10^{-3} torr while the gauge chamber was kept two orders of magnitude lower. We successfully discharged the optic. The discharge rate varied exponentially with charge level and operating current and nearly linearly with acceleration voltage, and peaked when the pressure was 8 x 10^{-3} torr in the main chamber.

1This work is supported by the National Science Foundation under grant PHY-0757801.
Based on preliminary DFT calculations. The results of calculations performed in conjunction with the present work will also be reported. Based on this analysis the asymmetric stretching fundamental of SiC$_5$ was observed at 936.9 ± 0.2 cm$^{-1}$. The measured isotopic shifts are in good agreement with the predictions of DFT calculations. This information will help in identifying SiC$_5$ in circumstellar and interstellar environments. Also, it has potential applications for optoelectronic and semiconductor devices.

Fourier transform infrared (FTIR) study on SiC$_5$ gas mixtures at Thousands of Kelvin. MARTIN ABEL, LOTTHAR FROMMHOLD, The University of Texas at Austin, XIAOPING LI, KATHARINE L. C. HUNT, Michigan State University — The interaction-induced absorption by collisional pairs of H$_2$ molecules is an important opacity source in the atmospheres of the outer planets and cool stars [1]. The emission spectra of cool white dwarf stars differ significantly in the infrared from the expected blackbody spectra of their cores, which is largely due to absorption by collisional H$_2$–H$_2$, H$_2$–He, and H$_2$–H complexes in the stellar atmospheres. Using quantum-chemical methods we compute the atmospheric absorption from hundreds to thousands of kelvin [2]. Laboratory measurements of interaction-induced absorption spectra by H$_2$ pairs exist only at room temperature and below. We show that our results reproduce these measurements closely [2], so that our computational data permit reliable modeling of stellar atmosphere opacities even for the higher temperatures [2]. [1] L. Frommhold, Collision-Induced Absorption in Gases, Cambridge University Press, Cambridge, New York, 1993 and 2006 [2] Xiaoping Li, Katharine L. C. Hunt, Fei Wang, Martin Abel, and Lothar Frommhold, “Collision-Induced Infrared Absorption by Molecular Hydrogen Pairs at Thousands of Kelvin”, International Journal of Spectroscopy, vol. 2010, Article ID 371201, 11 pages, 2010. doi: 10.1155/2010/371201

10:36AM FM1.00004 FTIR Argon Matrix and DFT Study of the Vibrational Spectrum of SiC$_5$.1, T.H. LE, W.R.M. GRAHAM, Texas Christian University, TCU MOLECULAR PHYSICS LAB TEAM — This is the first Fourier transform infrared (FTIR) study on SiC$_5$, which is a part of ongoing FTIR and density functional theory (DFT) research, investigating the structures and vibrations of silicon-carbon molecules. Vibrational spectra of SiC$_5$ were obtained by Nd:YAG laser ablation of a sintered rod, made of $^{13}$C-enriched graphite and silicon, and trapping the resulting vapor in solid Ar at ~15 K. The $\nu_5(\sigma_u)$ asymmetric stretching fundamental of SiC$_5$ has been observed at 936.9 ± 0.2 cm$^{-1}$. The measured isotopic shifts are in good agreement with the predictions of DFT calculations. This information will help in identifying SiC$_5$ in circumstellar and interstellar environments. Also, it has potential applications for optoelectronic and semiconductor devices.

11:00AM FM1.00006 Characterization of Resonant Cavities in Terahertz Parallel Plate Waveguides. BLAKE MCCCRACKEN, VICTORIA ASTLEY, RAJIND MENDIS, DAN MITTLEMAN, Rice University — Parallel-plate waveguides are among the most common low-loss broadband waveguides in the terahertz frequency regime with a large variety of applications. One application is microfluidic detection. Adding a groove into one of the waveguide plates leads to a resonant feature of relatively high quality factor, which will shift to different frequencies when the groove is filled with different liquids. We experimentally investigate the resonant frequencies and transmission characteristics of different-sized grooves in aluminum plates in order to determine which groove will be most suitable for microfluidic sensing. This apparatus is formed by machining grooves of varying geometries into aluminum plates which are then used to form parallel-plate waveguides. Sub-picosecond terahertz pulses are used to excite the lowest-order transverse-electric (TE1) mode in the waveguides and the output spectrum is analyzed to determine the resonant frequency and Q-factor of each groove geometry. We can use the information gathered in order to determine which groove gives the highest quality factor (Q-factor), increasing the sensitivity of a groove-based microfluidic sensor.

11:12AM FM1.00007 Quantum lithography beyond the diffraction limit via Rabi oscillations. ZEYANG LIAO, Texas A&M University, MUHAMMAD AL-AMRI, MUHAMMAD SUHAIL ZUBAIRY — We propose a quantum optical method to do the sub-wavelength lithography. Our method is similar to the traditional lithography but adding a critical step before dissociating the chemical bound of the photoresist. The subwavelength pattern is achieved by inducing the multi-Rabi-oscillation between the two atomic levels. The proposed method does not require multiphoton absorption and the entanglement of photons. It is expected to be realizable using current technology.

11:24AM FM1.00008 Structures and Vibrational Spectra of Potential Astrophysical Molecules: MnC$_3$. MICHELNE BEJJANI, MAGNUS RITTBY, WILLIAM GRAHAM, Texas Christian University — This study on MnC$_3$ is part of an ongoing project investigation of the structures and vibrations of small metal-carbon clusters using Fourier transform infrared (FTIR) spectroscopy and density functional theory (DFT). These species are of interest as potential species in circumstellar shells or other astronomical environments and for understanding the structure and bonding of larger metal-carbide molecules such as metallocarbohedrenes. MnC$_3$ was produced by trapping the products from the dual laser Nd:YAG lased ablation of carbon and manganese rods in solid Ar at ~12 K. Fourier transform infrared measurements of frequencies and $^{12}$C isotopic shifts were compared with the predictions of density functional theory calculations performed for three possible structures: two cyclic isomers with transannular C-C or C-Mn bonds and an asymmetric linear form. Based on this analysis the asymmetric stretching fundamental $\nu_5(\sigma_u)$ has been identified at 1846.9 cm$^{-1}$. This is the first optical detection of any isomer of MnC$_3$. A previous study by photoelectron spectroscopy [1] reported evidence for the cyclic isomer with transannular Mn-C stretch based on preliminary DFT calculations. The results of calculations performed in conjunction with the present work will also be reported.

11:48AM FM1.00005 Collision-Induced Infrared Absorption by Hydrogen-Helium gas mixtures at Thousands of Kelvin. MARTIN ABEL, LOTTHAR FROMMHOLD, The University of Texas at Austin, XIAOPING LI, KATHARINE L. C. HUNT, Michigan State University — The interaction-induced absorption by collisional pairs of H$_2$ molecules is an important opacity source in the atmospheres of the outer planets and cool stars [1]. The emission spectra of cool white dwarf stars differ significantly in the infrared from the expected blackbody spectra of their cores, which is largely due to absorption by collisional H$_2$–H$_2$, H$_2$–He, and H$_2$–H complexes in the stellar atmospheres. Using quantum-chemical methods we compute the atmospheric absorption from hundreds to thousands of kelvin [2]. Laboratory measurements of interaction-induced absorption spectra by H$_2$ pairs exist only at room temperature and below. We show that our results reproduce these measurements closely [2], so that our computational data permit reliable modeling of stellar atmosphere opacities even for the higher temperatures [2]. [1] L. Frommhold, Collision-Induced Absorption in Gases, Cambridge University Press, Cambridge, New York, 1993 and 2006 [2] Xiaoping Li, Katharine L. C. Hunt, Fei Wang, Martin Abel, and Lothar Frommhold, “Collision-Induced Infrared Absorption by Molecular Hydrogen Pairs at Thousands of Kelvin”, International Journal of Spectroscopy, vol. 2010, Article ID 371201, 11 pages, 2010. doi: 10.1155/2010/371201

1This work has been supported in part by the National Science Foundation through Grants AST-0709106 and AST-0708496.

1Work supported by the National Science Foundation Research Experience for Undergraduates - Rice Quantum Institute.

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Friday, October 22, 2010 10:00AM - 11:48AM –
Session FM2 Astrophysics, Astronomy, Space Science I University Center III Bexar Room, 1st floor - Daniel Boice, Southwest Research Institute
10:00AM FM2.00001 HEMO – The Hermean Exosphere Model of Oxygen: A Comprehensive Model for Interpreting Data from the MESSENGER and BepiColombo Missions to Mercury

EMMANUEL GROTHERE, University of Texas at San Antonio — A model, entitled Hermean Exosphere Model (HEMO) is presented. The main source processes that replenish the Hermean exosphere are ion sputtering, impact vaporization, and photoionization. The exosphere is also affected by gravity, photoionization, photodissociation, and solar radiation acceleration. In addition, HEMO will incorporate a magnetosphere model to simulate ion trajectories both for sputtering and post-release. The sole in-situ data of oxygen, from Mariner 10, suggests a near-ground density of 4.4 E4 /cm^3. In this same paper, the sodium near-ground density is given as 1.7 – 3.8 E4 /cm^3 [Shemansky, 1988]. The HEMO simulations aim to illuminate why oxygen detection is difficult, when it should be more abundant than sodium, since oxygen should account for 50% of the Hermean crust [Killen et al., 2005]. The Hermean exosphere is similar to the lunar one, with similar variations in density and pressure. HEMO will incorporate a variable exosphere model to account for different sets of regoliths, Hermean orbital locations, and quiet and active Sun values. Results will be averaged to predict oxygen densities in Mercury’s exosphere. The HEMO model results can aid in the interpretation of future oxygen data from the MESSENGER and BepiColombo missions to Mercury.

10:12AM FM2.00002 Lyapunov Exponent Criterion in the CR3BP

BILLY QUARLES, JASON EBERLE, MANFRED CUNTZ, ZDZISLAW MUSIEK, UT Arlington — Our specific focus is to describe the motion of an extra solar planet in a binary star system. We aim to accomplish this by using the methods of chaos theory as an alternative method to our previously established Hodograph method in the circular restricted 3-body problem (CR3BP). Previously Eberle et al. (2010) has shown that a parameter space exists depending only on the mass ratio \( \mu \) and distance ratio \( \rho \), which allowed them to identify regions of stability. Our method will validate the previous results while also providing more information relating to the presence of resonances and their effects on orbital stability. We extend the previous studies by increasing the simulation time, applying the method of Lyapunov exponents, calculating the time series spectrum of the orbit, and determining the Lyapunov dimension. The obtained results demonstrate that a system becomes unstable by orbit energy criterion and the maximum Lyapunov exponent characterizes the orbital stability. By applying the maximum Lyapunov exponent (MLE) to the parameter space, we determine a region of stability with MLE values larger than the surrounding region. The time series spectra and the Lyapunov Dimension methods are used to illustrate the reasons behind the stability plateaux which eludes to the resonance phenomena.

10:24AM FM2.00003 Location, Structure, and Motion of Jupiter’s Dusk Magnetospheric Boundary from ~1625 to 2550 R_J

R.W. EBERT, UTSA/SwRI, D.J. MCCOMAS, SwRI/UTSA, F. BAGÉNAL, CU-Boulder, H.A. ELLIOTT, SwRI — We examine plasma observations along Jupiter’s dusk magnetospheric flank from ~1625 to 2550 R_J using measurements from the SWAP instrument on New Horizons (NH). NH made sixteen magnetopause (MP) crossings that were identified by transitions between magnetotail/boundary layer and magnetosheath plasma. These transitions were either sharp, with the MP clearly separating two distinct plasmas, or comparatively gradual, where it was difficult to distinguish between different populations. The sheath distributions had high counts, were relatively wide in energy/charge (E/Q) and steadily decreased in speed. Flow speeds in the sheath were always higher (lower) when NH entered (exited) this region. A boundary layer was observed inside of the MP at several crossings. Its plasma was composed of light ions and the counts and mean E/Q were generally lower than sheath values indicating a lower density and speed. Estimates of angular displacement of the tail boundary compared favorably with a study of near Jupiter solar wind flow cone angle distributions. We propose that the outward crossings resulted from dawnward deflection and contraction of the tail from forward shocks/compression regions in the solar wind, the inward crossings from the duskward deflection and expansion of the tail from reverse shocks/rarefaction regions.

10:36AM FM2.00004 The effect of sunspots cycle on satellite orbit

M.A.K. LODHI, Texas Tech U — A satellite, traveling through the atmosphere, experiences a drag directly dependent on the atmospheric density. The fluctuation in the density thus affects the satellite’s orbit. The effect of solar modulation, via Earth’s atmosphere density, is experienced. A test case of a satellite orbit has been worked out to demonstrate this effect. The altitude of the satellite SSN 2909 for a period starting from 1970 to 2007 has been shown to have a variation in the fall for certain periodic intervals. The satellite fall is much steeper for the high and very gentle for lower ones. The variances in the intensity of the solar activity and the rate of change of altitude with respect to time for the same intervals. This shows that the fluctuations in the density do affect the satellite’s orbit, which in turn are in exact agreement with fluctuations in the sunspots cycle. It is thus concluded that steep falls in the satellite’s altitude occur when the sunspots activity is high and gentle changes occur during the low sunspots activity.

10:48AM FM2.00005 Time-history of the isotopic ratios in Titan’s atmosphere

KATHLEEN MANDT, HUNTER WAITE, JARED BELL, BRIAN MAGEE, Southwest Research Institute — Saturn’s moon Titan is the only moon with a significant atmosphere, with a surface pressure of 1.5 times the surface pressure of Earth’s atmosphere. The main constituents of Titan’s atmosphere are molecular nitrogen (98%) and methane (1%). Diffusion, escape and chemical processes fractionate the isotopic ratios \(^{14}N/^{15}N\) in N\(_2\), \(^{12}C/^{13}C\) in CH\(_4\), and D/H in CH\(_3\). Diffusion and escape result in a preferential loss of the lighter isotopes. Photochemistry may result in loss of the lighter isotopes in CH\(_4\), but has been shown to have the opposite effect for N\(_2\). A model constructed (Mandt et al. 2009) to track the isotopic ratios as a function of geologic time found that the \(^{14}N/^{15}N\) in N\(_2\) could not have evolved from the terrestrial ratio to its current value as a result of atmospheric escape, and that the \(^{12}C/^{13}C\) measured in CH\(_4\) limited the length of time for methane to have consistently resided in the atmosphere to less than 200 million years. Recent re-analysis of the Huygens GCMS data from Titan’s surface (Niemann et al. 2010) has revised both the \(^{14}N/^{15}N\) in N\(_2\) and \(^{12}C/^{13}C\) in CH\(_4\), resulting in significant changes to model results for the evolution of methane. We will present these updated results on the evolution of Titan’s atmosphere and discuss the implications for the history of Titan.

11:00AM FM2.00006 Further Measurements of the New Dwarf Nova J2138+26

JARED ROVNY, University of Dallas, KYLE MEZIER, IRINA VOLOSHINA, RICHARD OLENIK, VLADIMIR METLOV — J2138+26 is a new WZ Sge-type dwarf nova, discovered by Dae-Am Yi et al. on May 7, 2010 (CBET 2273). The object is suggested to be similar to GW Lib, another WZ Sge star outbursting in 2007, in terms of a low inclination angle and apparent brightness. J2138+26 is a binary star system with a variable light output caused by precession of the accretion disk around the white dwarf in the cataclysmic variable system. J2138 enters certain periods of outburst when it is significantly brighter, and its regular light variations (from precession), called superhumps, will have a changing amplitude and period of J2138, and the physical significance of these results discussed.
11:12AM FM2.00007 Density correlations between solar wind and pick-up ions with New Horizons/SWAP near 11 AU, BRENT RANDOL, UTSA/SwRI, DAVID MCCOMAS, SwRI/UTSA — The Solar Wind Around Pluto (SWAP) instrument aboard the New Horizons spacecraft measured ion energy spectra of the solar wind and pick-up ions between 11 and 12 AU in late 2008. We report on detailed fitting of these spectra using an empirical model that includes major solar wind ions (H+, He2+, and O6+) as well as pick-up ions (from the interstellar and inner sources). We find a correlation between the densities of the solar wind H+ ions and all other populations. The two strongest correlations are with the interstellar pick-up ions and the inner source pick-up ions. These results could have implications for transport of pick-up ions through the heliosphere.

11:24AM FM2.00008 Observation and Analysis of J1625 +1203, KYLE MEZIERE, RICHARD OLENICK, University of Dallas, IRINA VOLOSHINA, VLADMIR METLOV, Sternberg Astronomical Institute, JAREDD ROVNY, University of Dallas — We observed and classified the object, J1625 +1203, in July 2010, which was discovered by the Catalina Real Time Sky Survey. Observations of this cataclysmic variable star were made over a two week period using the 60 cm telescope at the Sternberg Institute Crimean Observatory in Nauchny, Ukraine. A total of eight nights of professional grade data was collected, which was then processed and analyzed. The light curves obtained are characteristic of a Su UMa type dwarf nova undergoing a super hump outburst. The super hump and orbital periods were calculated from the data and they further support the classification of J1625 as a Su UMa type dwarf nova. Data and characteristics of this object will be presented.

11:36AM FM2.00009 Interstellar Boundary Explorer (IBEX) Observations of the Outer Heliosphere, DAVID MCCOMAS, Southwest Research Institute — Global images of the heliosphere’s interaction with the local interstellar medium have recently been published using observations from the Interstellar Boundary Explorer (IBEX) mission [McComas et al., Science, 326, 5955, 2009 and related articles in the same issue]. IBEX observes energetic neutral atoms [ENAs] over the energy range from ∼100 eV – 6 keV emanating in from the interaction region at the edge of the heliosphere. In IBEX’s first sky maps, we discovered a narrow, bright ribbon of ENA emissions unpredicted by any prior models or theories that appears to be ordered by the interaction of the heliosphere with the local interstellar magnetic field. This ribbon is superposed on more slowly spatially varying globally distributed ENA flux, which is ordered by both the solar wind structure and the direction of motion through the interstellar medium. IBEX observations indicate that the external galactic environment strongly imprints the heliosphere. This talk summarizes the published IBEX observations, examines the possibility that the ribbon structure may be evolving over the six months between IBEX’s first and second sky maps, and discusses some of the possible ideas for what may be missing in our current understanding of the heliosphere’s global interaction and creating this remarkable ribbon structure.

Friday, October 22, 2010 10:00AM - 11:48AM –

Session FM3 Biological and Chemical Physics I
University Center I Pecan Room, 2nd floor - Ahmed Touhami, University of Texas at Brownsville

10:00AM FM3.00001 Laser damage thresholds for in vitro retinal pigment epithelial cell by micro thermal sensing1, TAE CHOI, DIENYE ATEMIE, University of North Texas, MICHAEL DENTON, GARY NOOJIN, LARRY ESTLACK, BENJAMIN ROCKWELL, ROBERT THOMAS, USAF AFMC 711 HPW/RHDO, USAF AFMC 711 HPW/RHDO COLLABORATION — A cellular-level, high-resolution temperature sensing system was developed using a micropipette thermocouple sensor. The sensing system was properly calibrated and tested for retinal pigment epithelial (RPE) cells. We have integrated this sensing system with an in-house fluorescence microscope to determine laser damage thresholds for RPE cells. At the damage thresholds, we have determined a maximum temperature rise of 40 °C at the position ∼5 µm away from the center of a cell. We have also acquired fluorescence images of the cell before and after irradiation. Disappearance of fluorescence clearly signifies the cell damage. Theoretical simulations for photothermal damage show similar trends in temperature rise.

1This work was performed in 711th Human Performance Wing/RHDO at Brooks City-Base and sponsored by ASEE summer faculty fellowship program.

10:12AM FM3.00002 Correlating Computational Docking Predictions with Raman Spectroscopy for Beta-Lactoglobulin-Porphyrin Complexes, JAMES PARKER, LORENZO BRANCA-LEON, The University of Texas at San Antonio — Computational molecular docking simulations (Dock and AutoDock) may provide a wealth of structural information related to the bound configuration of protein-ligand complexes, but they require verification to ensure their predictions reflect reality. Resonance Raman spectroscopy data has been collected to correlate normal mode vibrations observed in the bound structure to computationally generated structures in order to determine the best match between the computational model and experiment. This methodology was used to determine the bound structures at an atomistic level of β-lactoglobulin (BLG) and meso-tetraakis (p-sulfonatophenyl) porphyrin (TSPP) in aqueous solutions at pH 7 and 9. Comparisons of Raman spectra of TSPP before and after binding to BLG yield line shifts that are related to the distortions in the free molecule that are presumed to be generated by the non-covalent binding of the ligand to the protein. Our goal is to define quantitative relationships between the observed line shifts and the computed distortions in the molecular structure using normal mode analysis and DFT computational tools.

10:24AM FM3.00003 Synthesis of Giant Unilamellar Vesicles (GUV) from Liposomes Prepared by the Rapid Solvent Exchange (RSE) Method, EDA BAYKAL-CAGLAR, Texas Tech — Lipid bilayers, which is an important constituent of cell membranes, has been extensively studied by biophysicists. Cell membranes perform many vital cell functions such as signal transduction and transportation of materials needed for the functioning of the cell organelles. Understanding the organization and dynamics of lipid bilayers is important for understanding the processes taking place in cell membranes. Giant Unilamellar Vesicles (GUVs) are cell-sized model systems that allow direct visualization of membrane-related phenomena using fluorescence microscopy. In this study, we investigated the synthesis of GUVs from much smaller liposomes (less than 0.5 microns) produced by the Rapid Solvent Exchange (RSE) method in aqueous solutions of high and low ionic strength. The GUVs synthesized using RSE liposomes are more uniform in lipid composition than that synthesized by other methods. We made a number of modifications to the original electroformation method, and we are able to prepare GUVs from RSE liposomes both in high ionic strength and low ionic strength buffers. Using our optimized procedure, we are also able to produce high quality multi-component GUVs to study the dynamics of lipid domains.
10:36 AM FM3.00004 Binding of Perylene derivatives to Human Serum Albumin¹. MOHAMED FAROOQI, MATHIEU MAHINDARATNE, MARK PENICK, GEORGE NEGRETE, LORENZO BRANCELEON, University of Texas San Antonio — The binding and effects of polyaromatic hydrocarbons (PAH) on proteins remains a very important aspect in the study of the function of many proteins. We employ asymmetric perylene derivatives designed to optimize electron donating/accepting properties. Unlike the widely used perylene dlimides, these novel perylenes are synthesized with an array of possible electron donating and accepting group that would optimize photoinduced electron transfer (PET). Our study focuses on the interaction of four 3,9-substituted perylenes with Human Serum Albumin (HSA), which is the prime protein model for the binding of PAH. We present absorption and fluorescence spectroscopy results that help elucidate the binding of these perylenes to HSA. We determined that not all perylene derivative bind the protein and that their location is likely different.

¹University of Texas at San Antonio, NIH/NIGM (MARC U²STAR GM07717).

10:48 AM FM3.00005 Control of Stochastic Master Equation Models of Genetic Regulatory Networks by Approximating Their Average Behavior, MEHMET UMIT CAGLAR, RANADIP PAL, Texas Tech — The central dogma of molecular biology states that “information cannot be transferred back from protein to either protein or nucleic acid.” However, this assumption is not exactly correct in most of the cases. There are a lot of feedback loops and interactions between different levels of systems. These types of interactions are hard to analyze due to the lack of data in the cellular level and probabilistic nature of interactions. Probabilistic models like Stochastic Master Equation (SME) or deterministic models like differential equations (DE) can be used to analyze these types of interactions. SME models based on chemical master equation (CME) can provide detailed representation of genetic regulatory system, but their use is restricted by the large data requirements and computational costs of calculations. The differential equations models on the other hand, have low calculation costs and much more adequate to generate control procedures on the system; but they are not adequate to investigate the probabilistic nature of interactions. In this work the success of the mapping between SME and DE is analyzed, and the success of a control policy generated by DE model with respect to SME model is examined. Index Terms— Stochastic Master Equation models, Differential Equation Models, Control Policy Design, Systems biology

11:00 AM FM3.00006 Probing Protein Conformation Changes in Food Nanostructure, AHMED TOUHAMI, University of Texas at Brownsville, MARCELA ALEXANDER, University of Guelph, Guelph, Ontario, Canada, MILENA CORREDIG, University of Guelph, Guelph, Ontario, Canada — Here we use AFM—single molecule force spectroscopy to probe the conformational changes in Beta-lactoglobulin (BLG) protein adsorbed onto the oil-in-water interface due to variations in pH. Single oil droplets are mechanically trapped and the AFM tip is used to trap and unfold BLG molecules. The changes in the contour length upon each unfolding event were determined by fitting the WLC model of polymer elasticity to each of the BLG peaks of the force-extension profiles. Our results show clearly that BLG on the same oil droplet adopts different conformations at different pH regions. While at pH 2.5, the unfolded BLG has a contour length similar to the total length of single monomer with two large unfolding barriers, the protein exists mainly as a dimer formed of several smaller domains at pH 6.8. Furthermore, at pH 9 the interactions between the AFM tip and the BLG layer on the oil droplet are dominated by an important repulsion due to the highly negatively charged BLG layer. This study demonstrates a novel application of single molecule force spectroscopy to investigate the underlying mechanisms by which proteins can be used to stabilize food products.

11:12 AM FM3.00007 Particle Tracking of Fluorescent Microspheres¹. ZOFIA KAMINSKI, Department of Physics, University of Dallas, Irving, TX 75062, JOACHIM MUELLER, SERKAN BERK, Department of Biophysics, University of Minnesota, Minneapolis, MN, 55455 — In this addiional focus was to see how well the measured radius of the microspheres compared to the radius as reported by the manufacturer and to measure the distribution of radii in a sample. This study further developed the critical process of ensuring particle movement within the sample volume and made preliminary sample measurements. The methods developed for tracking microspheres will later be used to determine the radii of virus like particles (VLPs), which are a non-infectious model system of the HIV virus. Results from our measurements will be reported.

¹This research was funded in part by the National Science Foundation through their REU program.

11:24 AM FM3.00008 pH Dependant Binding and Irradiation of Protoporphyrin IX to Human Serum Albumin. SARAH ROZINEK, LORENZO BRANCELEON, UTSA — Irradiation of the non-covalent complex, protoporphyrin IX (PPIX) bound to β-lactoglobulin (β-lg), causes a modest unfolding of the protein localized to Trp19. PPIX binds to β-lg at a site affected by the pH of the solution. At physiological pH, PPIX is known to bind HSA in hydrophobic binding sites located in subdomain IIa and IIa. However, no evidence is presented for the binding behavior of PPIX to HSA in non-physiological pH conformations, nor the effects of irradiation on the bound system at any pH. The combination of spectroscopic data and molecular simulations suggests that distinct PPIX-compatible binding sites become available at each confirmation of HSA at pH 3, 7, 4, and 9.

11:36 AM FM3.00009 Expression of Trans-Membrane Proteins in vitro Using a Cell Free System. NATALIE WEISSE, University of Dallas, VINCENT NOIREAUX, University of Minnesota, JEROME CHALMEAU, University of Dallas — Trans-membrane proteins represent a significant portion of the proteins expressed by cells. The expression of proteins in vitro, however, remains a challenge. Numerous expression approaches have been developed with cell free expression (CFE) being one of the most promising. CFE is based on a transcription-translation system that has been extracted from E. coli bacteria. Adding the desired DNA allows expression of a selected protein, and in the presence of phospholipids the expression of trans-membrane proteins becomes possible. In order to express trans-membrane proteins in a closed native environment, the cell free system (CFS) is encapsulated with a phospholipid bilayer, creating an artificial cell. To verify protein expression, AquaporinZ (AqpZ), a well-known trans-membrane protein tagged with a green fluorescent protein (gEFP), was used so the expressed proteins could be seen under a fluorescent microscope. These artificial cells will serve as an experimental platform for testing the viability of the expressed trans-membrane proteins. Results from the manipulation of these artificial cells by attaching them to the slide surface through streptavidin-biotin bonding will be presented.

Friday, October 22, 2010 10:00 AM - 12:00 PM – Session FM4 High Energy/Nuclear University Center III Harris Room, 2nd floor - Carlos Bertulani, Texas AM University-Commerce
10:00AM FM4.00001 Construction and Testing of Scintillating Fiber Hodoscope readout with a Multianode Photomultiplier, KENNETH VERLAGE, Student Researcher, NURAL AKCHURIN1, Professor of Physics — We constructed two scintillating fiber hodoscope arrays to measure horizontal and vertical position of high energy beam particles. We used 0.83mm diameter fibers arranged in a staggered configuration to allow for unique position determination with 96 pixel photomultipliers. The sensitive area consisted of 4 cm by 7 cm. We present results on the crosstalk measurements using xp1724 photomultipliers.

1High Energy Physics Group at Texas Tech University

10:12AM FM4.00002 Construction of TAMU3: A 14 Tesla Nb3Sn Model Dipoles, EDDIE HOLIK, Texas A&M University, RAYMOND BLACKBURN, NICK DIACENKO, TIM ELLIOTT, ANDREW JAISLE, ALFRED MCINTYRE, PETER MCINTYRE, DIOR SATTAROV — The third phase of the Texas A&M University Accelerator Research Lab’s “Stress-Managed” high field magnet campaign has coil modules for the assembly of TAMU3. The third phase is the high field, $B_{max} \geq 12 – 14$ Tesla, proof of principle testing of the “Stress-Managed” coil fabrication design philosophy. Earlier dipole phases operated in the 6 – 8 Tesla range using NbTi and early bronze (ITER) Nb3Sn based superconductor. These third phase dipole winding modules use the tin rich multi-filament Nb3Sn/Cu composite strand with its enhanced engineering current density therefore have the possibility of producing magnetic fields $> 14$ Tesla, when combined with the evolution of much higher efficiency insulation. There are five modules under construction altogether, which are at various stages. The best performing pair during testing of these modules will comprise the upper and lower modules of TAMU4, a 4x2 cm aperture accelerator prototype dipole. There has also been progress in the fabrication and measurement techniques necessary to validate more accurately the “Stress-Management” approach.

1This work was supported in part by the U.S. Department of Energy, Office of High Energy Physics under Grant DE-FG03-95ER40924.

10:24AM FM4.00003 Scientific analysis of materials and designs to increase reliability and performance of RF Superconductivity Cavities1, NATHANIEL POGUE, PETER MCINTYRE, AKHDIYOR SATTAROV, Texas A&M University, CHARLES REECE, Thomas Jefferson National Lab — Texas A&M in collaboration with Jefferson Lab has put together an investigative plan for analyzing material performance and design of Niobium superconducting cavities. A sample test cavity is being designed to analyze the materials used during construction to identify the main inhibiting factors of performance, or accelerating gradient achievable. Once these phenomena are known, enhancements can be made to the surface to push to even higher limits thus reducing the cost and with higher gradients. These enhancements are new layered surface treatments that can be put down using a sophisticated cluster tool obtained by A&M. Once these layers are tested and certified as being extremely useful, the only means of applying them is through an open assembly cavity design, or polyhedral cavity. This cavity has many advantages: ease of machining, visible analysis, open cleaning, iris size reduction, and elimination of instabilities caused by other fields. This plan can dramatically change the landscape of common practices in high performance niobium cavities.

1Supported by DOE grant DEFG0210ER41650.

10:36AM FM4.00004 Pressure Dependence Studies on UTA GEM Based Digital Hadron Calorimeter, EDWIN BALDELOMAR, University of Texas Arlington - HEP — The University of Texas at Arlington High Energy Physics group has been developing a Digital Hadron Calorimeter (DHCAL) for the future International Linear Collider (ILC) using the Gas Electron Multiplier (GEM) technology. The group has built several prototype chambers of dimension 30cmx30cm. The prototypes have been successful in measuring charges deposited from traversing incident particles from cosmic ray and radioactive sources. The data was taken using the KPiX ASIC chips. This presentation includes the pressure variance of the GEM chamber and thus correcting for gain using cosmic and Fe 55 data through KPiX. In addition, the significance of the results to the future development of actual GEM DHCAL for use in the ILC experiments.

10:48AM FM4.00005 Capacitive Stress Transducers in High-Field Superconducting Magnets, CHRISTOPHER BENSON, PETER MCINTYRE, AL MCINTURFF, ANDREW JAISLE, TREY HOLIK, Texas A&M University — The dipoles needed for hadron colliders pose extreme challenges for the distribution of Lorentz stress within the coils. A strategy for stress management has been developed at Texas A&M University. Part of that development utilizes capacitive stress transducers to monitor the Lorentz forces within the coil packages. Constructing repeatable and reliable stress transducers has required the development of new tooling and procedures to streamline fabrication and calibration processes. The design, tooling and fabrication techniques used for capacitive stress transducers will be described along with the effect of improvements on the repeatability and performance of the transducers.

11:00AM FM4.00006 Simulations for the NIFFTE High Precision TPC, REMINGTON THORNTON, Abilene Christian University, NIFFTE COLLABORATION — The Neutron Induced Fission Fragment Tracking Experiment has designed a Time Projection Chamber (TPC) to measure neutron induced fission cross-section measurements of the major actinides to sub-1% precision over a wide incident neutron energy range. These measurements are necessary to design the next generation of nuclear power plants. In order to design a TPC capable of making these measurements, a precise simulation was required to ensure better track reconstruction. Using the Geometry And Tracking (Geant4) simulation platform along with standalone code, a complete simulation package has been written. Asynchronous trigger, 3-D charge diffusion, capacitive charge sharing, digitization, random trigger cells, and noise from the electronics have been modeled inside the detector response simulation, along with code that generates bi-products of fission events for Geant4. This talk will discuss the current status and future planned developments of this work including the efforts to make this code reusable for future TPC projects.

11:12AM FM4.00007 Track Reconstruction in a Time Projection Chamber Designed to Make High Precision Fission Cross Section Measurements, SARVAGYA SHARMA, Abilene Christian University, NIFFTE COLLABORATION — The TPC (Time Projection Chamber), being constructed by the NIFFTE (Neutron Induced Fission Fragment Tracking Experiment) collaboration will be used for high-precision fission cross-section measurements. These measurements will aid in the design of future generations of nuclear power plants. The NIFFTE track reconstruction effort has developed two approaches consisting of a variety of statistical estimators. The first, consists of traditional cluster and hit finding algorithms that are performed on 2D planes. A least squares is performed on the hits to produce a track in the TPC. The alternate approach uses the Hough Transform, a brute force attempt at finding tracks that isolates features in the TPC volume through data binning. To determine fit parameters, a Kalman Filter has been implemented that accounts for multiple scattering and kinks in the track. Comparing simulated and reconstructed tracks have shown the validity of these methods. The software uses open source packages to ensure re-usability for future TPC projects. In my talk, I will describe these methods in detail.
11:24AM FM4.00008 Electron screening and its effects on Big-Bang nucleosynthesis1

BIAO WANG, CARLOS BERTULANI, Texas A&M University-Commerce, A. BAHA BALANTEKIN, University of Wisconsin — We study the effects of electron screening on nuclear reaction rates occurring during the Big Bang nucleosynthesis epoch. The sensitivity of the predicted elemental abundances on electron screening is studied in detail. It is shown that electron screening does not produce noticeable results in the abundances unless the traditional Debye-Hückel model for the treatment of electron screening in stellar environments is enhanced by several orders of magnitude. The present work rules out electron screening as a relevant ingredient to Big Bang nucleosynthesis.

1Supported by the U.S. DOE and the Research Corporation.

11:36AM FM4.00009 SCALE 6.1 Validation Testing: Unit Cell Data and Material Input

PAUL STAUDUHAR, University of Dallas, BRAD REARDEN, DOUGLAS PELOW, ORNL, CHRIS PERFETTI, University of Michigan, OSCAR LASTRES, University of Tennessee, HEATHER CONNAWAY, MIT, DAVID HARTMANGRUBER, Georgia Tech — SCALE (Standardized Computer Analysis for Licensing Evaluation) computer program code system is used by the Nuclear Regulatory Commission, other regulating agencies, and scientists to perform important calculations for nuclear facilities and the transportation and storage of nuclear material. The SCALE 6.1 update improved computational abilities over previous versions. SCALE 6.1 must accurately execute all of the functions from SCALE 6.0 and be backwards compatible. A test suite was developed that implements the various modules of SCALE 6.1 and tests them against certain benchmark problems known to execute correctly in SCALE 6.0. The research reported here, conducted at Oak Ridge National Laboratory, consisted of testing all parameters of the CENTRM/PMC and XSDRPM functional modules, unit cell geometry data, and the material input processor of the SCALE code system. By creating a set of test problems based on certain benchmarks, specific indicating values are compared with known correct values to evaluate the accuracy between the software versions. My test suite and the test suites of four other testers will be part of a comprehensive tool sent with all new software packages of the SCALE 6.1 release.

11:48AM FM4.00010 Nuclear high-K isomers viewed in extended deformation space

HONGLIANG LIU, Texas A&M University-Commerce, FURONG XU, Peking University, CARLOS BERTULANI, Texas A&M University - Commerce — Multi-quasiparticle high-K isomers in heavy and superheavy nuclei are studied by configuration-constrained potential-energy-surface calculations extended to include reflection asymmetry or high order deformation. Actinide nuclei are found to be good candidates for the formation of high-K isomers in the second well of the potential-energy surface. The calculations with reflection asymmetry explain the inhibition of isomeric fission as being mainly attributed to the increased height of the fission barrier. Remarkable effects of high order deformation on $^{251}$No high-K isomers are found using calculations with $\beta_6$ deformation. The high order deformation leads to increased binding energies and enhanced deformed shell gaps at $N = 152$ and $Z = 100$. The inclusion of $\beta_6$ deformation significantly improves the description of the very heavy high-K isomers.

Friday, October 22, 2010 10:00AM - 11:12AM

Session FM5 Condensed Matter and Nanoscience I

10:00AM FM5.00001 Barium Titanate nanoparticles: using nonlinearity for biomarkers and phase conjugate nano-mirrors1

BRIAN YUST, NEEMA RAZAVI, DHIRAJ SARDAR, The University of Texas at San Antonio — Barium titanate (BaTiO₃) is a well known crystal with strong nonlinear optical properties and has been widely used for phase conjugation through four-wave mixing. Recently, it has been reported that these nonlinear properties are still exhibited on the nanoscale. BaTiO₃ particles of varying size are synthesized through precipitation and hydrothermal methods and analyzed optically and morphologically. The nonlinear signals from forward four wave mixing and non-degenerate four wave mixing are verified and characterized. The correlation between wave mixing signal strength and particle size is also investigated. Finally, rare earth ions such as neodymium and europium are doped into BaTiO₃ particles. Both the fluorescent properties and changes in the nonlinear optical properties are studied. The application of these particles as biomarkers and possible phase conjugate nano-mirrors is also discussed.

1This research was supported by the National Science Foundation Grant No. DMR-0934218.

10:12AM FM5.00002 Investigation of the size distribution of nanoparticles produced by Laser Ablation of Microparticles

NATHAN ERICKSON, KAY HOFFMANN, JOHN KETO, The University of Texas at Austin — Theory has predicted that the size distribution of nanoparticles produced by the Laser Ablation of Microparticles (LAM) process will produce a distribution that follows the log-normal curve. The work that has been done recently in our group investigated for the first time the low end of the predicted log-normal distribution of the LAM process: an area of interest that has been previously eluded observation due to detector resolution. A Wiley-McLaren TOF mass spectrometer was used to detect smaller sized nanoparticles that are traditionally below the resolution of a TEM microscope.

10:24AM FM5.00003 Holographic Imaging in Carbon Nanotube and Dye-Doped Liquid Crystal

SAUNAB GHOSH, MIKAIL ABBASOV, West Texas A&M University, GENE CARLISLE, DEPARTMENT OF PHYSICS TEAM — Without application of electric field, we recorded permanent holographic images in the nematic liquid crystal E7, doped with 0.6% Methyl Red (MR) and 0.002% single-wall carbon nanotubes (CNTs). The images were recorded using a 488-nm laser and reconstructed using 488-nm, 532-nm and 633-nm probe beams. Multi-order diffraction patterns were observed, during image recording and reconstruction, for thin films having thicknesses of 15 μm. The quality and diffraction efficiency were higher for cells containing both CNTs and MR than for cells doped only with MR. Average first-order diffraction efficiencies of 7.1% and 3.7% were found for the (CNT+MR)-cells and MR-only cells, respectively. The primary objective of this study was to utilize the molecular properties of MR and CNTs to produce a liquid crystal material with improved holographic properties. Dynamics of image formation and a proposed CNT-enhancement mechanism are presented. The holograms are robust and have remained stable for over two years.
10:36AM FM5.00004 Down- and Up-Conversion emissions from Er$^{3+}$/Yb$^{3+}$ co-doped tellurite glass for solar cell application¹, MADHAB POKHREL, UTSA, DEBNATH RADHABALLABH, School of Laser Science and Engineering, DHIRAJ SARDAR, UTSA — Monogap solar cells, like silicon solar cells, are unable to absorb the entire solar spectrum. Importantly, photons with high energy are known to have thermalization losses and photons with an energy lower than the band gap energy cannot be absorbed. Materials which convert one UV photon into one or two lower energy photons (down-converters) and materials which convert two or more sub-bandgap photons into high energy photons (up-converters) are of great interest for photovoltaic application. In this work, three properties have been analyzed for Er$^{3+}$/Yb$^{3+}$ co-doped on tellurite glass: (a) we investigate its potential application as a up and down conversion material, (b) investigate the suitability as an enhancer in various solar cells based on band gap engineering, and (c) model to utilize these unique spectroscopic properties in future photovoltaic device as a fluorescent collectors.

¹This research was supported by the National Science Foundation Grant No. DMR-0934218.

10:48AM FM5.00005 Fluorescence Spectroscopy of Single-Walled Carbon Nanotubes in Epoxy¹, PAUL WITHEY, KENA SENEGAL, SARENA SENEGAL, TAMIKI THOMAS, Northwestern State University, SERGEI BACHILO, R. BRUCE WEISMAN, Rice University — Single-walled carbon nanotubes (SWCNTs) have been successfully embedded into EPON 862/W epoxy both with and without a surfactant. Near-infrared fluorescence imaging and spectroscopic studies of individual carbon nanotubes (CNTs) within these nanocomposites indicate very good separation of individual CNTs with little bundling. Application of strain to the nanocomposites permitted the interfacial adhesion between the CNT and host to be studied at the single-particle level. Shifts in the emission spectrum of individual semiconducting SWCNTs clearly indicate load transfer. Loss of adhesion, or slipping, has also been detected for some nanotubes as changes in their emission spectra. Near-infrared fluorescence imaging and spectroscopy are proving to be ideal methods for monitoring the behavior of SWCNTs within nanocomposites, especially at the single-particle level. Much of this work has been carried out by undergraduate physics and chemistry majors.

¹Support from the Air Force Minority Leaders Program and generous use of facilities in the lab of Dr. R. Bruce Weisman at Rice University are gratefully acknowledged.

11:00AM FM5.00006 Investigation of Eu doped TiO$_2$ thin films¹, EDWARD KHACHATRYAN, ERIK ENRIQUEZ, FRANCISCO PEDRAZA, CHONGLIN CHEN, DHIRAJ SARDAR, University of Texas at San Antonio — We present second harmonic generation from Eu doped Titanium oxide (TiO$_2$) thin films deposited on different substrates (glass, Si, LaAlO$_3$, MgO) by sputtering in different conditions. Atomic Force Microscope (AFM) was used to measure the grain size and the boundaries of the samples. Transmission Electron Microscope (TEM) was applied to study the morphology, crystal structure and for interface imaging. Spectroscopic characterization and comparison between different deposition conditions and substrates also will be presented.

¹This research was supported by the National Science Foundation Grant No. DMR-0934218.

Friday, October 22, 2010 10:00AM - 12:00PM – Session AAPT2.00001 Pre-Lab and Lab Activities in Newtonian Mechanics Multidisciplinary Building MS 3.02.16 -

10:00AM AAPT2.00001 Pre-Lab and Lab Activities in Newtonian Mechanics –

Friday, October 22, 2010 1:30PM - 2:42PM – Session FI2.00001 Near-horizon expansion (conformal) approach to the calculation of Black Hole entropy in ‘t Hooft’s brick-wall model, CARLOS ORDONEZ, University of Houston — A review and the latest results on the near-horizon expansion (conformal) approach to ‘t Hooft’s brick-wall model calculation of Black Hole entropy developed recently by the speaker and his collaborators will be given in this talk. With mainly a graduate student audience in mind, the seminar will be pedagogical in nature, with emphasis on the ideas and logic of the methods and the insights gained with this approach more than on details. If time permits, possible future directions will also be mentioned.
2:06PM F12.00002 Standing-wave plasmon resonances in THz metamaterials. XOMALIN PERALTA, Department of Physics and Astronomy, UTSA — Metamaterials are man-made composite materials designed to have specific electromagnetic properties that go beyond those found in naturally occurring materials. The most common implementation of a metamaterial utilizes a metallic resonant particle periodically distributed in an insulator matrix where the periodicity is significantly smaller than the wavelength of operation. Their electromagnetic properties arise from the interaction of the resonator units with either or both the incident electric and magnetic fields and are manifested as resonances in the spectra of the metamaterials. Understanding how these properties arise will better enable the development of devices that exploit them, such as negative index materials, superlenses and invisibility cloaks among others. We fabricated split-ring resonators with a resonant response in the terahertz (THz) range of the electromagnetic spectrum (0.1 – 10 THz; 3000 – 30 microns) due to ease of fabrication and the considerable application potential for communications, spectroscopic imaging and chemical or biological sensing. They were fabricated using standard photolithographic techniques on a large-area, lowstress, free-standing silicon nitride membrane. We characterized them using terahertz time domain spectroscopy (THz-TDS) and a Fourier transform infrared (FTIR) spectrometer equipped with terahertz optics. Our results show multiple resonances in the THz region both, for electric fields polarized parallel and perpendicular to the development of devices that exploit them, such as negative index materials, superlenses and invisibility cloaks among others. We fabricated split-ring resonators with a resonant response in the terahertz (THz) range of the electromagnetic spectrum (0.1 – 10 THz; 3000 – 30 microns) due to ease of fabrication and the considerable application potential for communications, spectroscopic imaging and chemical or biological sensing. They were fabricated using standard photolithographic techniques on a large-area, low-stress, free-standing silicon nitride membrane. We characterized them using terahertz time domain spectroscopy (THz-TDS) and a Fourier transform infrared (FTIR) spectrometer equipped with terahertz optics. Our results show multiple resonances in the THz region both, for electric fields polarized parallel and perpendicular to the meta-material units, i.e. standing-wave plasmon resonances.

Friday, October 22, 2010 3:00PM - 5:00PM — Session FA1 Atomic, Molecular, and Optical Physics II University Center III Travis Room, 2nd floor - Andrey Chabanov, University of Texas at San Antonio

3:00PM FA1.00001 Whispering-Gallery Modes in Quantum Dot-Embedded Microspheres. HOPE BEIER, NRC/Air Force Research Laboratory, KENITH MEISSNER, Texas A&M University — Optical resonances, known as Whispering Gallery Modes (WGMs), from quantum dot embedded polystyrene microspheres offer potential for remote detection of molecules adsorbed onto or bound to the microsphere surface. The total internal reflection of the quantum dot (QD) emission light within the high index polystyrene microsphere produce narrow spectral peaks that shift position with variations in the local refractive index sampled by the evanescent tail of the WGMs. QD-embedded microsphere response has demonstrated increased sensitivity over theoretical predictions for a homogeneous microsphere. By considering the embedded QDs as a high index outer layer, the positions, Q-factor, and sensitivity of the WGMs were modeled. This model, along with estimates of the QD-layer index and penetration depth, was used to relate the locations and sensitivities of the modes to our experimental results with strong agreement between the two.

3:12PM FA1.00002 Experimental and Numerical Studies of Thermal Lensing in Optical Materials. SAMANTHA FRANKLIN, USAF 711 HPW/RHDO — A common issue found in near-IR laser applications with multi-kW beams is thermo-optical effects due to small levels of absorption of the optical material used in the beam train elements. To validate current beam propagation codes for this application, a closed-aperture Z-scan experiment was performed. Commercially available NG11 and NG4 (Schott glass) absorptive neutral density filters were used as the sample with optical densities ranging from 0.1-0.5. They were exposed with a 532 nm beam at 100mW power for 1 s at different z-positions in the optical path. The experimental parameters were entered into the computer model and the irradiance vs. position (in meters) of the computer model output data was compared to the graph of normalized irradiance vs. z-position (in meters) of the Z-scan experiment. Experimentally measured values were compared to calculations from the laser propagation model; the results of this comparison showed that the modeling program is a proper measuring tool in the outcome of a thermal lensing experiment. Public Release Code: AFRL-RH-AB-2010-0043 PA#: 10-350

3:24PM FA1.00003 Controllable optical switch by a Bose-Einstein condensate in an optical cavity. SHUAI YANG, Institute for Quantum Studies and Department of Physics, Texas A&M University, College Station, TX 77843, USA, MOHAMMAD AL-AMRI, The National Center for Mathematics and Physics, P.O. Box 6086, KACST, Riyadh 11442, Saudi Arabia, JORG EVERS, Max-Planck Institut for Kernphysik, Saupfercheckweg 1,D-69117 Heidelberg, Germany, M. SUHAIL ZUBAIRY, Institute for Quantum Studies and Department of Physics, Texas A&M University, College Station, TX 77843, USA — The optical bistability of the combination of the optical cavities and ultra cold atomic ensembles is investigated. We find that the transverse pumping field can be used to control the bistable behavior of the intra cavity photons induced by the input pumping along the cavity axis. This phenomenon can be used as a controllable optical switch.

3:36PM FA1.00004 High Energy Scattering from all Isotopomers of H2. STEVEN ALEXANDER, Northwestern University, R.L. COLDWELL, University of Florida — Using variational Monte Carlo and simple, explicitly-correlated fully-nondiabatic wavefunctions for the lowest rovibrational state of all the H2 isotopomers, we have computed cross sections for the elastic and inelastic scattering of fast electrons and X-rays. Our results are in good agreement with the calculations of Kolos, Monkhorst and Szalewicz (J. Chem. Phys. 77, 1323 (1982)).

3:48PM FA1.00005 Optimizing coherent anti-Stokes Raman scattering by genetic algorithm controlled pulse shaping. WENLONG YANG, ALEXEI SOKOLOV, Institute for Quantum Science and Engineering and Department of Physics & Astronomy, Texas A&M University, College Station, TX 77843-4242 USA — The hybrid coherent anti-Stokes Raman scattering (CARS) has been successful applied to fast chemical sensitive detections. As the development of femto-second pulse shaping techniques, it is of great interest to find the optimum pulse shapes for CARS. The optimum pulse shapes should minimize the non-resonant four wave mixing (NRFWM) background and maximize the CARS signal. A genetic algorithm (GA) is developed to make a heuristic searching for optimized pulse shapes, which give the best signal the background ratio. The GA is shown to be able to rediscover the hybrid CARS scheme and find optimized pulse shapes for customized applications by itself.

1Robert A. Welch Foundation
4:00PM FA1.00006 Surface Plasmon Polariton Propagation, Interference and Diffraction, JACOB AJIMO, CHARLES REAGAN, AYRTON BERNUSSI, Nanotech Center, Texas Tech University, LUIS GRAVE DE PERALTA, PHYSICS DEPT, TEXAS TECH UNIVERSITY TEAM, NANOTECH CENTER, TEXAS TECH UNIVERSITY TEAM — Interest in plasmonics calls for in depth characterization of surface plasmon polaritons. We present a series of experiments done to investigate the propagation, interference and diffraction of surface plasmon polaritons. Leakage radiation microscopy was used to image the in plane propagation of surface plasmon polaritons resulting in demonstration of a plasmonic quantum eraser. Fundamental aspects on the propagation of the SPPs based on experimental results will be presented. Experimental and simulation results on the use of dielectric loaded surface plasmon polariton waveguides will be discussed.

4:12PM FA1.00007 Carrier-Envelope Phase Effects in Multi-Photon Processes, PANKAJ JHA, Texas A&M University, YURI ROSTOVTSEV, University of North Texas, HEBIN LI, VLADIMIR SAUTENKOV, Texas A&M University, MARLAN SCULLY, Texas A&M University and Princeton University — We present an experimental and theoretical study of the carrier-envelope phase (CEP) effects in multi-photon excitation process between two bound atomic states interacting with intense pulses consisting of many cycles (up to 15 cycles) of the field. Radio frequency pulses with Rabi frequency of the order of the atomic transition frequency are used to transfer population among the ground state hyperfine levels in rubidium atoms. We have found that, for long pulses consisting two frequencies, the CEP of the pulses strongly affects that transfer. Extending the CEP control to longer pulses creates interesting possibilities to generate pulses with accuracy that is better than a period of laser oscillation.

4:24PM FA1.00008 Speckle Statistics of Localized Waves in Random Media, ABE PENA, ANDREY CHABANOV, Department of Physics and Astronomy, University of Texas at San Antonio, JING WANG, AZRIEL GENACK, Department of Physics, Queens College of City University of New York — The onset of single-channel transport in multi-channel disordered systems due to Anderson localization is observed in speckle pattern statistics. These statistics have been gathered with microwave radiation transmitted through an ensemble of quasi-1D random dielectric samples of length two times the localization length. In a single-channel regime, the transmission speckle pattern exhibits a “perfect memory” effect: A shift in the direction and/or polarization of the incoming wave leaves nearly unchanged the positions and relative brightness’s of speckles, while leading to large fluctuations of total transmission. The probability distribution of single-channel microwave transmittance (conductance) as determined from the measurements of speckle intensity statistics is compared to those predicted for localized waves.

4:36PM FA1.00009 Coherent control of Casimir force in chiral medium, JABIR HAKAMI, QINGQING SUN, SUHAIL ZUBAIRY, Texas A&M University — Chirality has been previously reported as a way to obtain repulsive Casimir forces [PRL 103, 103602 (2009)]. Here we propose the coherent control of the Casimir force between two identical atomic chiral media. We apply a magnetic field to split the detuning as well as the refractive indexes for the two circular polarizations, which leads to chirality. Changing the strength of this magnetic field gives us different Casimir forces, and possibly a switch between attractive and repulsive forces.

4:48PM FA1.00010 Spectroscopic Ellipsometry of Gadolinium Gallium Oxide thin films, KALEB GILBERT, KUNAL BHATNAGAR, STEVE JACKSON, Angelo State University, RAVINDRANATH DROOPAD, WILHELMUS GEERTS, Texas State University, TONI SAUNCY, Angelo State University — The dielectric parameters of Gadolinium Gallium Oxide (GGO) multilayer structures have been investigated with spectroscopic ellipsometry and modeled with a simplified modeling technique. The GGO thin films are of varying thickness and the simple four parameter model was effective in determining consistent values for the dielectric constants of this important high k dielectric material. Ellipsometric data was collected in a specific acquisition configuration related to the tilt of the elliptically polarized light upon reflection from the GGO sample. The model is further confirmed by the determination of film thickness values within an acceptable range when compared with those reported by the sample grower.

Friday, October 22, 2010 3:00PM - 4:48PM –
Session FA2 Astrophysics, Astronomy, Space Science II University Center III Bexar Room, 1st floor - Soma Mukherjee, University of Texas at Brownsville

3:00PM FA2.00001 Laser Stabilization Techniques for Gravitational-wave Detectors, SERGIO CANTU, MALIK RAKHMANOV, VOLKER QUETSCHKE, Department of Physics, University of Texas at Brownsville — The Laser Interferometer Gravitational-Wave Observatory (LIGO) consists of two 4-km detectors whose mission is to directly observe fluctuations of space-time called gravitational waves. To achieve the necessary sensitivity these detector require precise control of the displacements of many components of the interferometer, and high level of stability of the laser frequency and the purity of laser mode. We present a summary of the experiments with laser stabilization techniques utilized on the LIGO Pre-Modecleaner (PMC) cavity and the Interferometric Displacement Sensor (IDS). The PMC is a triangular ring resonator which suppresses the high order modes in the laser beam, keeping the fundamental mode unaffected, thereby improving the mode content of the laser beam. The IDS based on a simple Michelson interferometer has the sensitivity of 10 fm/Hz which greatly exceeds the sensitivity of the commercial devices (on the order of 10 pm/Hz) which are currently used by LIGO. We measured the performance of both PMC and IDS in table optical interferometer experiments.

3:12PM FA2.00002 The Formation of Spaces in the Universe and Its Expansion, JAMES WANG — This article considers multi-layered space. A model for longitudinal space is presented indicating the cause of interaction and relationship among the longitudinal spaces. An interpretation is presented for the real cause of the “gravitational force” phenomenon. The universe as stated in physics can be large or small. It is believed that the universe is made up of many multi-layered, independent but interacting spaces and times. Here, we want to emphasize that the interaction we speak of is a one-way interaction from higher spaces to lower spaces. The effect may also be restricted to a limited number of spaces.
reactants, as well as preparation methods may significant affect on the overall behavior of the oxygen generation rate. The specific application factors affecting to ignition and performance characteristics of SFOG have shown that many physical and chemical properties of the individual particles. Furthermore, we determined the influence of the nitrate/glycine ratio on the crystallinity and particle grain size of the Co surface contact area between the solid reagents and homogeneity of mixture as well as improves the uniformity of reaction thermal front. We allow reduction of the overall reaction temperature and elimination of the hot temperature fluctuations. The nano size reactant increases the learnability by the algorithm for making it an effective approach for real LIGO data analysis.

Preliminary results indicate that such an enhancement can potentially bring about a forty fold increase in computational efficiency while suffering minor degrade in model quality. A current future direction is in further improving quality of models learned by the algorithm for making it an effective approach for real LIGO data analysis.

We derive analytic solutions for the potential and field in a one-dimensional system of masses or charges with periodic boundary conditions, in other words Ewald sums for one dimension. We also provide a set of tools for exploring the system evolution and show that it’s possible to construct an efficient algorithm for carrying out simulations. In the cosmological setting, we compare two approaches for satisfying periodic boundary conditions, one overly specified and the other completely general. We demonstrate that they provide a nearly identical clustering evolution until the number of clusters becomes small, at which time the influence of any size-dependent boundary cannot be ignored. Finally we compare the results with other recent work with the hope of providing clarification over differences these issues have induced. We explain that modern formulations of physics require a well defined potential which is not available if the forces are screened directly.

The data collected in the science run of LIGO calls for a thorough analysis of the glitches seen in the gravitational wave channels, as well as in the auxiliary and environmental channels. Rapid growth in size and number of available databases requires fast and accurate data mining algorithms for timely glitch analysis. The study presents a new technique in cluster analysis that we call constrained validation clustering (CV clustering) for mining patterns in gravitational wave burst triggers. The approach avoids using Gaussianity assumptions on data distribution, and was shown to outperform a state of the art in clustering – G-means – when K, the number of clusters, is unknown (Tang et al., 08); experimental results suggested that Guassian mixture assumption can be too strong as a machine learning bias in mining gravitational wave data, evidenced by very severe overfitting of data by G-means. Our current focus is on upgrading CV clustering to utilizing random sampling and stochastic optimization techniques. Preliminary results indicate that such an enhancement can potentially bring about a forty fold increase in computational efficiency while suffering minor degrade in model quality. A current future direction is in further improving quality of models learned by the algorithm for making it an effective approach for real LIGO data analysis.

The Laser Interferometer Gravitational wave Observatory (LIGO) is taking data at its sixth science run (S6). As the sensitivity of the detectors increased, so did the rate of glitch production. Understanding the glitches by studying their parameters has become much more important since production of science data of the highest quality is one of the top priorities. We present here a technique of glitch studies through isolation of waveforms of the glitches and classifying them using multidimensional techniques that would enable us to understand the properties of each glitch and find their linkages with other subsystems in the detector.

A possible physical mechanism for understanding the self-similar evolution is introduced. It is shown that hierarchical cluster formation depends on both on the model and the initial power spectrum. Under special circumstances a simple relation between the power spectrum, correlation function, and correlation dimension in the highly nonlinear regime is confirmed.

The solid fuel oxygen generators (SFOG) used as backup oxygen delivery systems for International Space Station (ISS). Well established SFOG formulations include sodium/lithium chlorite and metal micro-particles. However, common SFOG are accompanied by formation of high temperature spots, which decrease the efficiency and safety performance. In this report we present multicomponent nanostructured oxygen generators (NOGs) based on NaClO₃·Sn-C₅O₃ system that allow reduction of the overall reaction temperature and elimination of the hot temperature fluctuations. The nano size reactant increases the surface contact area between the solid reagents and homogeneity of mixture as well as improves the uniformity of reaction thermal front. We describe here a novel one-step (metal nitrate–glycine) solution combustion synthesis of nanostructured highly crystalline cobalt oxide nanoparticles. Furthermore, we determined the influence of the nitrate/glycine ratio on the crystallinity and particle grain size of the Co₃O₄. The factors affecting to ignition and performance characteristics of SFOG have shown that many physical and chemical properties of the individual reactants, as well as preparation methods may significant affect on the overall behavior of the oxygen generation rate. The specific application of SFOG requires that the ignition and performance characteristics be tailored to have precise sensitivities and oxygen outputs.
4:36PM FA2.00009 GM=tc³ Cosmology and the Moon . LOUISE RIOFRI - Relativity suggests an expanding cosmology of scale R = ct, where t is age of the Universe. Gravitation would then require that c be further related to t by: GM = tc³. Where G and M are mass and gravitational constant, this simple expression predicts data from the microwave background, including 4.507034% baryonic matter and a stable density Ω = 1. The non-linear increase in Type Ia supernova redshifts may be precisely predicted without repulsive energies. (Riofrio, 2004) Prediction of a changing c may be tested with modern lanterns and the distant hilltop of the Moon. Our Lunar Laser Ranging Experiment has measured the Moon’s semimajor axis increasing at 3.82 ± 0.03 cm/yr, anomalously high. The Mansfield sediment (Bills, Ray 2000) measures lunar recession at 2.9 ± 0.6 cm/yr. More recent work accurately measures a recession rate of 2.88 ± 0.05 cm/yr. LLRE differs from independent experiments by 10σ. If the speed of laser light were decaying, the Moon’s apparent distance is predicted to increase by 0.935 cm/yr. An anomaly in the Moon’s orbit is precisely accounted for. This interesting result may have importance for cosmology, shedding light on puzzles of “dark energy.” In Planck units, this may be summarised as: M = R = t.

Friday, October 22, 2010 3:00PM - 4:48PM - Session FA3 Biological and Chemical Physics II University Center I Pecan Room, 2nd floor - Robert Thomas, Air Force Research Laboratory

3:00PM FA3.00001 Automatic quantification of early transition points in biofilm formation . TRAVIS THATCHER, SAMUEL BIENVENU, SHINJI STRAIN, VERNITA GORDON, Department of Physics, University of Texas at Austin — Biofilms are multicellular, dynamic communities of interacting single-cell organisms, like bacteria. Biofilms are responsible for many infectious diseases as well as for significant damage in industrial settings, yet many aspects of biofilm formation are not well understood. Identifying and quantifying the interactions leading to biofilm formation will not only be important for understanding the basic science of these and other multicellular systems, but it will also be essential for designing targeted strategies to prevent or disrupt biofilms. In particular, it is not clear what physical interactions, and corresponding biological mechanisms, are responsible for the early steps in biofilm formation. Because of this, we are developing high-throughput software techniques to analyze micrograph movies of biofilm formation, from attachment to surfaces through the development of microcolonies. This work will focus on developing software tools to identify and quantify key steps in biofilm formation, first in non-chemotactically stimulated and later in chemotactics (and autotacting) systems.

3:12PM FA3.00002 NanoLithography-Based Micro/Nano-patternning techniques of polymer brushes. , FERNANDO MONJARAZ, DIPIKA PATEL, SOYEUN PARK¹, Department of Physics Texas Tech University — The fabrication of micro/nano-patterned polymer brushes has been a challenge due to unique interfacial properties originated from the strong confinement and the dominant edge effects. We have developed unique bottom-up fabrication to synthesize polymer brushes grafted on the nanoparticle arrays created by NanoSphere Lithography (NSL). We used spin-coating and capillary action deposition to create the nano-particle arrays. Through UV-driven radical polymerization, based on infers selectively coupled on nanoislands, the polymer-PMMA chains were grown from nano-particle arrays. The superimposed patterns were transferred using conventional photo-lithography. AFM topographic images showed the swelling behavior of polymer chains in good solvents, confirming the selective growth of polymers on nanoislands. We also found that the mechanical and kinetic properties of polymer brushes grafted on nanoislands are strongly governed by dominant edge effects by analyzing the AFM force spectroscopy.

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3:24PM FA3.00003 Utilizing E. coli Autotactic Responses to Understand Quorum Dependent Behaviors in P. aeruginosa . SHINJI STRAIN, SAMUEL BIENVENU, TRAVIS THATCHER, VERNITA GORDON, Center for Nonlinear Dynamics, University of Texas at Austin — Biofilms are multicellular, surface-bound communities of interacting unicellular organisms. In the initial stages of biofilm formation, cells populate the surface and eventually form microcolonies (dense surface-bound clusters of cells). How much these microcolonies arise from clonal growth and how much they arise from attraction and binding of non-clonal cells is not well-understood. A potentially important form of attraction is autotaxis, movement of cells toward like cells. Using microscopy and automated tracking and analysis algorithms, we will study how bacteria respond to each other in a spatially-dependent manner. We will determine how variations in neighbor density and arrangement stimulate changes in cell motility. E. coli will be our initial model system, and later we will probe early biofilm formation in P. aeruginosa. We will also study chemotaxis (motility toward an attractive chemical), to understand how this drives, complements, or competes with autotaxis in different settings.

3:36PM FA3.00004 Photo-Thermal Ablation of Single Neurons Using Gold Nanostars , ZURAB KERESELIDZE, Dept. Physics and Astronomy, UTSA, VICTOR ROMERO, CIQ, Mexico, WASKAR EGIDO, Dept. Biology, UTSA, CHRISTOPHER VALDES, EMMANUEL MICHAELIDES, Dept. Biology, UTSA, XOMALIN PER-ALTA, MIGUEL JOSE-YACAMAN, Dept. Physics and Astronomy, UTSA, FIDEL SANTAMARIA, Dept. Biology, UTSA — Nanoparticle mediated photo-thermal ablation therapy is a promising technique for the treatment of multiple illnesses. It has been characterized in bulk tissue, but little is known about its effects at the single-cell level. Photo-thermal ablation works by exciting the surface Plasmon resonance of metal nanoparticles to cause an amplification of the absorption of the incident electromagnetic field, which is transformed into heat through various processes. We have fabricated gold nanostars with a surface plasmon mode in the near infrared via a modified seed-mediated method. Neurons from mouse cerebellar slices internalize the bare nanostars during incubation periods of < 3 hrs. Using a two-photon microscope, we imaged the tissue slices and excited the surface plasmon mode of the nanoparticles. Our results showed that we are capable of destroying individual nanostars containing cells without affecting their neighbors. Therefore nanostars can provide a technique for single-cell photo-thermal ablation of neurons with no functionalization.

3:48PM FA3.00005 Measuring Forces of Bacterial Biofilms on Substrates , BENJAMIN COOLEY, VERNITA GORDON, Center for Nonlinear Dynamics, University of Texas at Austin — Biofilms are multicellular aggregates of microorganisms with distinct gene expression and often complex spatial structure. Understanding the forces exerted by bacterial biofilms on their substrates could help in understanding damage they cause in industrial settings and to living tissue in biofilm infections. Here we propose a series of experiments to study the forces between biofilms and substrates using rheological and micro-rheological techniques. Polystyrene tracer beads embedded in agar gels can be mapped over the course of biofilm development, and these timelapse motions will show the strain in the substrate. Meanwhile, measurements of the Brownian motion of selected tracer beads can yield information about the microstructure of the agar. For instance, the extent of the Brownian motion will be increased if the agar is stretched apart or broken down. Additionally, tracers in the biofilms themselves would permit the study of the rheology of the biofilms throughout their development.
4:00PM FA3.00006 Using a Microwave Resonant Cavity to Study Hydrogen Bonding at Phase Transition in H\textsubscript{2}O and D\textsubscript{2}O. JAMES ROBERTS, University of North Texas, JAI DAHIYA — 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 behavior in the dielectric response of H\textsubscript{2}O as it is cycled from solid to liquid. The transition through the densest state of water near 4\textdegree C indicates that the order of the water molecules in the ice phase is less than that experienced 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. Phase transition from liquid to solid and solid to liquid was studied for H\textsubscript{2}O and D\textsubscript{2}O. It is expected that the bonding of the two molecules will behave the same during the transition from ordered to disordered states and in the reverse transition. The apparatus used in this investigation will be discussed.

4:12PM FA3.00007 Chemotaxis in P. Aeruginosa Biofilm Formation. SAMUEL BIENVENU, SHINJI STRAIN, TRAVIS THATCHER, VERNITA GORDON, UT Austin — Pseudomonas biofilms form infections in the lungs of Cystic Fibrosis (CF) patients that damage lung tissue and lead to death. Previous work shows chemotaxis is important for Pseudomomas in CF lungs. The work studied swimming bacteria at high concentrations. In contrast, medically relevant biofilms initiate from sparse populations of surface-bound bacteria. The recent development of software techniques for automated, high-throughput bacteria tracking leaves us well-poised to quantitatively study these chemotactic conditions. We will develop experimental systems for such studies, focusing on L-Arginine (an amino acid), D-Galactose (a sugar present in lungs), and succinate and glucose (carbon sources for bacteria). This suite of chemotactants will allow us to study how chemotactant characteristics—size and diffusion behavior—change bacterial response; the interaction of competing chemotactants; and, differences in bacterial behaviors, like motility modes, in response to different types of chemotactants and varying neighbor cell density.

4:24PM FA3.00008 AFM-based nano-mechanical clues for cancer metastasis. LYNDON BASTATAS, Department of Physics, Texas Tech University, RAUL MARTINEZ-ZAGUILAN, Departments of Cell Physiology and Molecular Biophysics, Texas Tech University Health Sciences Center, SOYEUN PARK. Department of Physics, Texas Tech University — We have evaluated if the nano-biomechanical properties of cells with distinct metastatic potential could provide a reliable indicator of cancer progression using low (LNCAp) and highly (CL1) metastatic prostate cancer cells. From threshold force-distance curves, we determined the cellular elastic moduli and adhesiveness in the local nano-domain of cells by applying the standard Hertz model and the advanced models. Using the AFM force spectroscopy, the two dimensional topographic, elastic, adhesive maps of an individual cell were successfully delineated. We found that the elastic moduli in CL1 are higher than in LNCAp. These results are paradoxical since greater cell deformability—hence low elastic moduli—is needed for highly metastatic cells to intra/extra-vasate for metastasis to ensue. However, our result also showed that CL1 strongly adheres on the substrate while the LNCAp poorly adheres. We postulate that the tensional force originated from the enhanced adhesion generates higher cortical tension, elicit dynamic intracellular calcium transit, and lead to the highly metastatic behavior.

4:36PM FA3.00009 Interactions and transitions in biofilm formation. VERNITA GORDON, University of Texas, Austin, KELLY COVLIN, University of Washington, Seattle, JACINTA CONRAD, University of Houston, MAXSIM GIBIAN-SKY, FAN JIN, University of California, Los Angeles, MATTHEW PARSEK, University of Washington, Seattle, GERARD WONG, University of California, Los Angeles — Biofilms are multicellular, interacting communities of intrinsically-unicellular organisms that grow on surfaces. As such, they are fascinating model systems for multicellularity. They are also of great practical importance, since biofilms damage a variety of industrial infrastructure and are the cause of most persistent, antibiotic-resistant infections. In natural settings, most bacteria are found in biofilms. To study these chemotactic conditions. We will develop experimental systems for such studies, focusing on L-Arginine (an amino acid), D-Galactose (a sugar present in lungs), and succinate and glucose (carbon sources for bacteria). This suite of chemotactants will allow us to study how chemotactant characteristics—size and diffusion behavior—change bacterial response; the interaction of competing chemotactants; and, differences in bacterial behaviors, like motility modes, in response to different types of chemotactants and varying neighbor cell density.

Friday, October 22, 2010 3:00PM - 5:00PM — Session FA4 Computational and General I University Center III Harris Room, 2nd floor - Zlatko Koinov, University of Texas at San Antonio

3:00PM FA4.00001 Dynamic Modeling and Simulation of a Real World Billiard. ALEXANDRE HARTL, North Carolina State University, BRUCE MILLER, Texas Christian University — Scientists have investigated gravitational billiards since they exhibit a variety of dynamical phenomena in nonlinear Hamiltonian systems. The system typically consists of a particle undergoing elastic collisions within a boundary, where the particle assumes a ballistic trajectory between collisions. This paper considers the more realistic situation of an inelastic, rotating, gravitational billiard in which there are retarding forces due to air resistance and friction. In this case the motion is not conservative, and the billiard is a sphere of finite size. Here we present a dynamical model that captures the relevant dynamics required for describing the motion of a real world billiard for arbitrary boundaries. An application of the model considers parabolic, wedge and hyperbolic billiards that are driven sinusoidally. Direct comparisons are made between the model’s results and experimental data previously collected. Although several studies have investigated the effect of variable elasticity in relation to the gravitational billiard, this study is the first to incorporate rotation and additional forms of energy dissipation.

3:12PM FA4.00002 Experimental Study of Ocean Mixing. BRUCE RODENBORN, GUENTHER EBERT, HARRY L. SWINNEY, Center for Nonlinear Dynamics, Dept. of Physics, UT Austin — Ocean circulation patterns, e.g. the Gulf Stream, depend on mixing produced by the tides and wind. These oceanic currents are critical in maintaining the earth’s climate. Global ocean and climate computer models parameterize mixing because it happens at such a small scale. The current understanding of ocean mixing requires about 20% of the kinetic energy in a turbulent flow to be converted into a change in the fluid’s gravitational potential energy. However, this value of mixing efficiency has never been confirmed in laboratory experiments. We study mixing in a fluid contained between two counter-rotating cylinders whose density, like the ocean, varies with height. Using sodium polytungstate salt solution, we achieve an initial vertical density variation of up to 200%, and then spin the cylinders to mix the fluid. Measurements are made for laminar (smooth) to fully turbulent flows. The flow pattern is visualized using Kalliroscope, and the characteristic vertical length scale is determined from spatial fourier transforms of images. The power input is determined by measuring the torque and rotation rate of both cylinders. The fluid’s gravitational potential energy is determined by measuring density as a function of height. We find that mixing efficiency is strongly dependent both on the rotation rates of the cylinders and the total initial density variation.
3:24PM FA4.00003 Analytical Comparisons of Tree Ring Data, Greenland Ice Core Temperatures and Temperature Fluctuations of the Sargasso Sea. JAMES ROBERTS, University of North Texas, JAI DAHIYA, Southeast Missouri State University — 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 provoke legitimate debate based on scientific data and processes rather than popular opinion or deduction by “experts” in climatology.

3:36PM FA4.00004 A new generalization of supersymmetric quantum mechanics to arbitrary dimensionality or number of distinguishable particles. THOMAS MARKOVICH, University of Houston — We present here a new approach to generalize supersymmetric quantum mechanics to treat multiparticle and multi-dimensional systems. We do this by introducing a vector superpotential in an orthogonal hyperspace. In the case of \( N \) distinguishable particles in three dimensions this results in a vector superpotential with \( 3N \) orthogonal components. The original scalar Schrödinger operator can be factored into vector “charge” operators: \( \vec{Q}_1 \) and \( \vec{Q}_2 \). Using these operators, we can write the original (scalar) Hamiltonian as \( H_1 = \vec{Q}_1 \cdot \vec{Q}_1 + E_0^{(s)} \).

The second sector Hamiltonian is a tensor given by \( H_2 = \vec{Q}_1 \vec{Q}_1^\dagger + E_0^{(t)} \) and is isospectral with \( H_1 \). The vector ground state of sector two, \( \psi_0^{(2)} \), can be used with the charge operator \( \vec{Q}_2 \) to obtain the excited state wave functions of the first sector. This can be used with the sector Hamiltonians alternating between scalar and tensor forms accommodating both variational and Monte Carlo methods to obtain approximate solutions to both scalar and tensor sectors. We demonstrate the approach with examples of a pair of separable 1D harmonic oscillators and the example of a non-separable 2D anharmonic oscillator (or equivalently a pair of coupled 1D oscillators).

3:48PM FA4.00005 Identifying Inertial Modes in a Hide-Titman Flow. MARY CATALANO, Department of Physics, University of Dallas, RÖBERT BLUM, DANIEL ZIMMERMAN, DON MARTIN, DANIEL LATHROP, IREAP, Department of Physics, University of Maryland — Inertial modes are internal wave patterns present within a bounded, rotating fluid being restored by the Coriolis force. Hide and Titman found that a cylindrical container filled with homogeneous liquid and having a thin disk mounted coaxially inside of it will display non-axisymmetric fluid flow when the differential rotation between the cylinder and the disk exceeds a critical threshold. Their essential geometry and setup were replicated and the fluid flow produced was analyzed to ascertain its relationship, if any, to the inertial modes of a cylinder annulus expressed in analytical form by Zhang, et al. Experimental data and analyses to correlate observed fluid flows with theoretical inertial modes will be presented.


4:00PM FA4.00006 Developing an Undergraduate Program in Energy Systems. JOHN FANCHI — Texas Christian University (TCU) is developing an undergraduate program in engineering that prepares students to become engineers with an emphasis in energy systems. Courses in the program include an overview of energy in society that is suitable for the general student population; a technical overview of traditional energy (coal, oil and gas), nuclear energy, and renewable energy; and courses that cover more specialized energy topics. Students participating in this program will improve their understanding of energy systems; be introduced to outstanding scientific and engineering problems; learn about the role of energy in a global and societal context; and evaluate contemporary issues associated with energy. The energy systems curriculum will improve student understanding of activities that are a major component of the economy. As engineering students graduate with an energy systems emphasis, they will take their places in society with a much more sophisticated understanding of energy-related issues affecting their community. This talk will present the status of the new program.

4:12PM FA4.00007 Schrödinger Equation from Hamilton-Jacobi Equation. DONALD H. KOBE, University of North Texas — The time-dependent Schrödinger equation is now considered fundamental and the time-independent Schrödinger equation is derived from it for stationary states. Historically, it was the other way around. Schrödinger obtained his time-independent equation first and then obtained the time-dependent equation for time-independent potentials. He then postulated it to be valid in general. We use the classical Hamilton-Jacobi equation to obtain both the time-dependent Schrödinger equation and the equation of continuity. We first derive Schrödinger’s “Ansatz” for the action \( S \) in terms of the wave function. By this change of variables the Hamilton-Jacobi equation is transformed into a complex equation. The equation of continuity is obtained from the imaginary part. The real part and the remaining imaginary part are combined to give a Schrödinger equation with a nonlinear term that is a remnant of the Hamilton-Jacobi equation. When this nonlinear term is dropped the linear time-dependent Schrödinger equation is obtained. This approach fills a gap in the development of the time-dependent Schrödinger equation. It also shows the intimate connection between classical and quantum mechanics.

4:24PM FA4.00008 Motor Controls for the NIFFTE Time Projection Chamber Positioning Stand. DANIEL PAMPLIN, NATHAN PICKLE, Abilene Christian University, NIFFTE COLLABORATION — The next generation nuclear power plants will be more efficient and produce smaller amounts of radioactive waste. Design of these new reactors is limited by the possibility of a nuclear explosion. Fusion reactions are classified as cold fusion reactions. In order to reduce the uncertainty of the cross sections to less than 1%, a Time Projection Chamber (TPC) was built by the Neutron Induced Fission Fragment Tracking Experiment (NIFFTE) collaboration. These improvements in precision will be possible due to the TPC’s ability for a full 3-D reconstruction of the fission fragment tracks. The NIFFTE TPC will be installed at Los Alamos National Lab’s LANSE facility. Thin targets will be mounted in the center of the TPC in a pressurized hydrogen gas chamber so that both hemispheres of the reaction will be covered. This target is divided into the positioning system. The positioning system includes the motors that drive the positioning table of the TPC, which has all of its readout electronics attached, to be lined up with the beam. This includes both the controlling software and its graphical interface to the MIDAS online data acquisition system.
The microstructure is reported to the following wire fabrication that can preserve the texture. The influence of the different applied fields and compression on the texture and uniaxial compression. Both methods generate highly textured Bi-2212 powder layers having a-b plane in the flat dimension, which is preferable.

We developed two methods by which to align the particles of Bi-2212 powder in thin layers. The first utilizes magnetic fields and the second is available Bi-2212 round wires do not have a macroscopical texture due to formation of HAGBs during the Partial-melt processing. In this study, TEAM — High angle grain boundaries (HAGBs) result in weak links in the current flow in high temperature superconductors. Commercially available Bi-2212 round wires have been measured at the University of Kentucky 7 MV Van de Graaff laboratory using neutron time-of-flight techniques. The neutron beam was produced using the $^2\text{H(p,n)}\text{He}$ reaction. The scattered neutrons were detected at angles between 20° and 150° in 10° intervals with a hexafluorobenzene detector located approximately 3 m from the scattering samples. Neutron scattering differential cross sections were deduced. These cross sections and their uncertainties are important for understanding neutron-induced reactions in fission reactors and are important for fission reactor criticality calculations.

This research was funded through the Department of Energy through the Nuclear Energy University Program and by the Cowan Physics Fund at the University of Dallas.

Friday, October 22, 2010 3:00PM - 5:00PM –
Session FA5 Condensed Matter and Nanoscience II University Center III Ballroom I, 1st floor - Marcelo Marucho, University of Texas at San Antonio

3:00PM FA5.00001 Microstructural and transport properties of highly epitaxial (LaBa)Co$_2$O$_{5+\delta}$ thin films on (001) SrTiO$_3$. CHUNRUI MA, MING LIU, JIAN LIU, GREG COLLINS, CHONGLIN CHEN. University of Texas at San Antonio. JIE HE, JIECHAO JIANG, EFSTATHIOS MELETIS. University of Texas at Arlington. ALLAN JACOBSON, University of Houston. UNIVERSITY OF TEXAS AT SAN ANTONIO TEAM, UNIVERSITY OF TEXAS AT ARLINGTON TEAM, UNIVERSITY OF HOUSTON COLLABORATION — The (LaBa)Co$_2$O$_{5+\delta}$ thin films were epitaxially deposited on (001) SrTiO$_3$ single crystal substrates by pulsed laser deposition. Microstructure investigations from x-ray diffraction and transmission electron microscopy reveal that the films are a-axis orientation with a sharp atomic interface. Transport property and isothermal magnetoresistance measurements have been used to understand the physical properties of the films with anomalous magnetic phenomena and the largest reported MR value, for LBCO, of 19% at 40 K.

3:12PM FA5.00002 From carbon nanotubes to carbon atomic chains. GILBERTO CASILLAS GARCÍA, University of Texas at San Antonio, WEIJIA ZHANG, MIGUEL JOSÉ-YACAMÁN — Carbyne is a linear allotrope of carbon. It is formed by a linear arrangement of carbon atoms with sp-hybridization. We present a reliable and reproducible experiment to obtain these carbon atomic chains using few-layer-graphene (FLG) sheets and a HRTEM. First the FLG sheets were synthesized from worm-like exfoliated graphite and then drop-casted on a lacey-carbon copper grid. Once in the TEM, two holes are opened near each other in a FLG sheet by focusing the electron beam into a small spot. Due to the radiation, the carbon atoms rearrange themselves between the two holes and form carbon fibers. The beam is concentrated on the carbon fibers in order excite the atoms and induce a tension until multi wall carbon nanotube (MWCNT) is formed. As the radiation continues the MWCNT breaks down until there is only a single wall carbon nanotube (SWCNT). Then, when the SWCNT breaks, an atomic carbon chain is formed, lasts for several seconds under the radiation and finally breaks. This demonstrates the stability of this carbon structure.

The authors of this work would like to thank the National ScienceFoundation PREM (Grant No. DMR-0934218) and Welch Foundation (Grant AX-1615) for their funding.

3:24PM FA5.00003 Study of texturing in Bi-2212 powder for wire development. FENG LU, KYLE DAMBORSKY, NATHANIEL POGUE, PETER MCINTYRE. Magnet Lab, Department of Physics, Texas A&M University, College Station, TX 77843, MAGNET LAB, DEPARTMENT OF PHYSICS, TEXAS A&M UNIVERSITY, COLLEGE STATION, TX 77843 TEAM — High angle grain boundaries (HAGBs) result in weak links in the current flow in high temperature superconductors. Commercially available Bi-2212 round wires do not have a macroscopical texture due to formation of HAGBs during the Partial-melt processing. In this study, we developed two methods by which to align the particles of Bi-2212 powder in thin layers. The first utilizes magnetic fields and the second is uniaxial compression. Both methods generate highly textured Bi-2212 powder layers having a-b plane in the flat dimension, which is preferable to the following wire fabrication that can preserve the texture. The influence of the different applied fields and compression on the texture and microstructure is reported.

This work was supported in part by DOE under grant DE-FG03-96ER40924. FE-SEM acquisition was supported in part by NSF grant DBI-0116835.
3:36PM FA5.00004 Surface Defect States in Nanopowder ZnO, YURI M. STRZHEMECHNY, Texas Christian University, Fort Worth, TX, RAUL M. PETERS, Paine College, Augusta, GA, JACOB SHAFFER1, Tarleton State University, Stephenville, TX, JAMES SCHULMAN2, Paschal High School, Fort Worth, TX, J. ANTONIO PARAMO, Texas Christian University, Fort Worth, TX — In our work we employed surface photovoltage (SPV) spectroscopy on a number of commercially available ZnO nanopowders to probe surface defect energies within the band gap, conduction vs. valence band nature of the defect-related transitions, as well as the surface photoresponse dynamics. SPV characterization was performed in ultra-high vacuum in situ with remote oxygen plasma treatments. Our experiments revealed a number of common spectral features related to surface states in the as-received and plasma-processed samples. Furthermore, we observed significant plasma-induced changes in the surface defect properties. Complementary ex situ photoluminescence measurements performed on the studied samples were correlated with the SPV results and demonstrated that our approach is efficient in detecting specific surface states in nanoscale ZnO specimens and in elucidating their nature.

1participant in TCU REU program, summer 2007, funded by NSF Grant 0851558
2participant in TCU RAP program

3:48PM FA5.00005 Development of a new Process for Fabricating Bi-2212/Ag Round Wire1, KYLE DAMBORSKY, FENG LU, PETER MČINTYRE, NATHANIEL POEGE, ELIZABETH SOOBY, Texas A&M University — Magnet technology required for the development of greater than 1 GHz NMR magnets, future hadron colliders, a proposed muon collider, and other applications above 25 T require a new generation of very high field superconducting wires. Presently, the only candidate material for manufacturing round wire in this operating range is Bi-2212/Ag composite conductor. Commercially available Bi-2212/Ag round wires are fabricated via a powder-in-tube (PIT) process which appears fundamentally limited by poor connectivity and a large degree of porosity after more than a decade of development. A modified jellyroll (MJR) conductor, designed to increase connectivity while decreasing porosity, is proposed for a new type of Bi-2212/Ag conductors. The method utilizes an oriented powder fabrication technique that allows the conductor to be constructed in a planar geometry, which is then wound to form a round wire for subsequent drawing and processing. The details of the fabrication process and preliminary results will be presented.

1This work was supported in part by DOE under grant DE-FG03-95ER40924. FE-SEM acquisition was supported in part by NSF grant DBI-0116835.

4:00PM FA5.00006 Spin spiral order and magnetization dynamics in magnetic nanowires1, OLEG TRETIAKOV, ARTEM ABANOV, Texas A&M University — I will talk about current-induced magnetization dynamics in a thin ferromagnetic wires with spin spiral order. This order is known to be caused by Dzyaloshinskii-Moriya interaction (DMI). We analytically find a spiral domain wall configuration of the magnetization and the domain wall width. Our findings show that above a certain value of DMI a domain wall configuration cannot exist in the wire. Below this value we determine the domain wall dynamics for small currents, and calculate the drift velocity of the domain wall along the wire. We show that the DMI suppresses the minimum value of current required to move the domain wall. It also may lead to increase of the domain wall drift velocity.

1This work was supported by the NSF Grant No. 0757992 and Welch Foundation (A-1678).

4:12PM FA5.00007 Modeling and simulation of charged particle beam transport in the UTA 2 meter Time of Flight Positron Annihilation Induced Auger Spectrometer1, PRASAD Joglekar, LAWRENCE Lim, SUSHANT Kalaskar, KARTHIK ShastrY, SUMAN Satyal, ALEXANDER Weiss2, U T Arlington — Time of Flight Positron Annihilation Induced Auger Electron Spectroscopy (TOF PAES) is a surface analytical technique with high surface selectivity. Almost 95% of the PAES signal originates from the sample's topmost layer due to the trapping of positrons just above the surface in an image-potential well before annihilation. This talk presents a description of the TOF technique as the results of modeling of the charged particle transport used in the design of the 2 meter TOF-PAES system currently under construction at UTA.

1Welch Foundation, NSF DMR0907679
2Advisor

4:24PM FA5.00008 The Development of a Two-Powder Process for Bi-2212 Precursor Powders, ELIZABETH SOOBY1, Texas A&M University: Department of Physics, TERRY HOLESINGER2, Los Alamos National Laboratory — Bi$_2$Sr$_2$Ca$_2$Cu$_2$O$_y$ (Bi-2212) is a prime candidate for high-field (>20 T) superconducting magnet applications, as it can be formed into a round wire conductor, a unique characteristic among all the high-temperature superconductors (HTS) discovered to date. Round wires are manufactured by conventional oxide powder-in-tube processes (OPIT). A critical part of this process is the quality of the starting oxide powder precursor, affecting the drawing processes to form wire, the development of the superconducting phase in-situ during heat treatments and the connectivity along the wire length. To better control the properties of the wire, we designed a two-powder process. We show that the number of phases present, as 2-powder process was developed. A set of anneals has been completed on the resulting precursor powder. Initial characterization indicates the process can produce Bi-2212, though further development is necessary.

1IGERT Fellow: Texas A&M University
2Materials Physics Applications Division: Superconducting Technology Center

4:36PM FA5.00009 Photoluminescence of etched SiC nanowires1, POLITE D. STEWART, JR., Southern University Baton Rouge, LA, RYAN RICH, T.W. ZERDA, Texas Christian University Fort Worth, Texas — SiC nanowires were produced from carbon nanotubes and nanosize silicon powder in a tube furnace at temperatures between 1100°C and 1350°C. SiC nanowires had average diameter of 30 nm and very narrow size distribution. The compound possesses a high melting point, high thermal conductivity, and excellent wear resistance. The surface of the SiC nanowires after formation is covered by an amorphous layer. The composition of that layer is not fully understood, but it is believed that in addition to amorphous SiC it contains various carbon and silicon compounds, and SiO2. The objective of the research was to modify the surface structure of these SiC nanowires. Modification of the surface was done using the wet etching method. The etched nanowires were then analyzed using Fourier Transform Infrared spectroscopy (FTIR), transmission electron microscopy (TEM), and photoluminescence (PL). FTIR and TEM analysis provided valid proof that the SiC nanowires were successfully etched. Also, the PL results showed that the SiC nanowire core did possess a fluorescent signal.

1This work was funded by the Department of Physics and Astronomy at Texas Christian University, the National Science Foundation through the Research Experiences for Undergraduates Site in Physics and Astronomy
4:48PM FA5.00010 Uncompensated Magnetization in FeF$_2$. KARIE BADGLEY, IGOR V. ROSCHCHIN, Department of Physics and Astronomy, Texas A&M University, MIKHAIL ZHERENKOV, MICHAEL R. FITZSIMMONS, LANSCE, Los Alamos National Laboratory, M. EREKHNINSKY, IVAN K. SCHULLER, Department of Physics, USCD, HUGO PONCE, ALDO H. ROMERO, CINVESTAV, Queretaro, Mexico, CASEY W. MILLER, Physics Department, University of South Florida — Exchange bias (EB) between a ferromagnet (FM) and an antiferromagnet (AF) manifests itself as a horizontal shift of the hysteresis loop below the critical temperature of the AF. While uncompensated magnetization has been shown to play an important role in EB, its origin is still unknown. To investigate the properties and origin of this uncompensated magnetization, AF-only samples were prepared. 36nm thick FeF$_2$ on MgF$_2$ coated with 3nm of Al to prevent oxidation. Using polarized neutron reflectometry and SQUID magnetometry, we measured the uncompensated magnetization in the samples and its depth profile. The magnitude of this magnetization is larger than what is expected from piezomagnetism or from ab-initio calculations of effects of FeF$_2$ surface relaxation on the uncompensated magnetization. Field and temperature dependence of this magnetization will also be presented. Funded by Texas A&M University, Texas A&M University–CONACyT Collaborative Research Grant Program, DOE, and NSF-9976899.

Friday, October 22, 2010 3:00PM - 4:48PM – Session FA6

3:00PM FA6.00001 Synthesis of Porous Silicon by non-contact etching with a strong oxidizer. D. OLIVIA SKEEN, TONI SAUNCY, Angelo State University — Porous silicon thin films have been produced by photochemical synthesis with a solution of hydrofluoric acid (HF) and the oxidizer cobalt nitrate. A 20mW HeNe laser was used to produce the local electric field necessary for the formation of the porous matrix on the surface of the crystalline silicon (n-type, antimony doped) substrate. Samples prepared with variations in process time from 15 minutes to 5 hours were examined using photoluminescence and Raman spectroscopy as well as scanning electron microscopy. Results indicate that the presence of the oxidizer during synthesis enhances the intensity of the photoluminescence produced by the porous silicon post-processing when compared with samples prepared using only HF. In addition, post process analysis reveals that the porous layer on the samples is present only on samples processed for less than 2 hours.

3:12PM FA6.00002 ALE Meta-Analysis of Schizophrenics Performing the N-Back Task. ZACHARY HARRELL, SPS — MRI/fMRI has already proven itself as a valuable tool in the diagnosis and treatment of many illnesses of the brain, including cognitive problems. By exploiting the differences in magnetic susceptibility between oxygenated and deoxygenated hemoglobin, fMRI can measure blood flow in various regions of the brain. This can determine the level of brain activity in relation to motor or cognitive functions and provide a metric for tissue damage or illness symptoms. Structural imaging techniques have shown lesions or deficiencies in tissue volumes in schizophrenics corresponding to areas primarily in the frontal and temporal lobes. These areas are currently known to be involved in working memory and attention, which many schizophrenics have trouble with. The ALE (Activation Likelihood Estimation) Meta-Analysis is able to statistically determine the significance of brain area activations based on the post-hoc combination of multiple studies. This process is useful for giving a general model of brain function in relation to a particular task designed to engage the affected areas (such as working memory for the n-back task). The advantages of the ALE Meta-Analysis include elimination of single subject anomalies, elimination of false/extra weak activations, and verification of function/location hypotheses.

3:24PM FA6.00003 The Search for the W' and Right-Handed Neutrino. GUY GRUBBS, SPS — In this experiment, a search was conducted for the W' and right-handed neutrino in the W' llqq channel. A program was created in order to read data, make cuts, and look for interesting data points. After this program was created, signals of different W' and right-handed neutrino masses were input along with data and cuts were made. The experiment was able to conclude with a 95% confidence level that a W' particle does not exist for right-handed neutrino masses of 100 and 300GeV. More signals of different W' and right-handed neutrino masses should be tested in order to set limits on their existence in this channel.

3:36PM FA6.00004 Developing functional Optical Tweezers for Undergraduate Research. TANYA DAX, TONI SAUNCY, Angelo State University — Optical tweezers are useful for manipulation of microscopic materials without damage from physical contact. This project utilized a 20mW HeNe laser (wavelength 632.8nm) and a reconfigured standard teaching-laboratory microscope to form a stable diffraction limited trap. A simple method of live recording of moving particles was developed with the use of AVT SmartView and NI Vision Assistant. The physical setup was altered several times to eliminate sources of misalignment, until an optimal configuration was achieved and optical trapping and manipulation of a polystyrene microsphere was successfully recorded. Additionally, Calcite particles on the order of 1 micrometer were manipulated with the optical trap.

3:48PM FA6.00005 Estimating the sheet resistance of a thin film with an Ohm-meter. ALAN WOODALL, WILHELMUS GEERTS, Texas State University — In order to get an estimate of the sheet resistance of a thin film sample, without having access to a four point probe measurement system, one could measure the resistance with a simple digital multimeter using two electrodes. For thin film materials that form a good electric contact with the chrome plated electrodes, the two point probe resistance measured by placing the two electrodes in the middle of the sample is proportional to the sheet resistance. The proportionality factor between the measured resistance and the thin film's sheet resistance appears to depend on the ratio of the electrode spacing (s) and the electrode diameter (d). For s/d is equal to 12, the proportionality factor is one, which means that the measured resistance is a good estimate of the film’s sheet resistance. The error is less than 10 percent for s/d values between 9 and 16.

4:00PM FA6.00006 Design and construction of a Hall Effect Measurement system. ETHAN GULLY, TRAVIS LITTLE, SEBASTIAN REQUENA, TONI SAUNCY, Angelo State University — We have constructed a Hall Effect sample holder that facilitates quick sample change and insures that the sample is uniformly located for each measurement. The 4 point off-the-shelf sample card was integrated into an existing floor magnet with custom designed and constructed mounts. The sample holder is well suited for these measurements, allowing for adjustments in all three of the coordinate axes directions so that even small samples can be accurately positioned for measurement between the poles of the magnet. The sample holder is interfaced and controlled with LABView software. The measurements are made using a suite ofKeithley instruments. The design and construction will be discussed and preliminary calibration of the Hall Effect system will be presented.

1Supported from Angelo State Carr Research Foundation and Heterofunctional Materials Initiative from the Office of Naval Research.
4:12PM FA6.00007 MicroBooNE: Proton Decay Background Studies JESSICA ESQUIVEL, RICHARD CARDENAS, St. Mary’s University — MicroBooNE is a Liquid Argon Time Projection Chamber detector (LaTPC) that detects and analyzes neutrino interactions using the Fermilab booster neutrino beam as well as the Neutrinos from the Main Injector beam (NuMI). This experiment was proposed to look into the excess of low energy neutrino events observed by the Mini-BooNE experiment. Unlike MiniBooNE, MicroBooNE has the capability to distinguish between electrons and photons. MicroBooNE is also able to see proton decay modes that Water Cherenkov detectors like Super K aren’t able to see. MicroBooNE is a benchmark for all future massive Liquid Argon (LAr) detectors and because of this, MicroBooNE will also be used to study Proton Decay background rejection, Particle Detection, and Readout procedures.

4:24PM FA6.00008 Science Policy: Behind the Scenes TRAVIS BARNETT, Angelo State University — I served nine weeks as an intern in the House of Representatives Committee on Science and Technology. For the majority of the summer I served in the Research and Science Education Subcommittee, researching, among other things, cyber-enabled learning, cybersecurity, and alternate energy costs. My internship was created and funded by the John and Jane Mather Foundation for the Arts and Sciences, and as the only merit-based science committee intern, I felt a great responsibility to prove my worth in the Committee. Immersed in government and science policy, I feel very learned and prepared to participate in these fields.

4:36PM FA6.00009 Interaction of Mastoparan with Model Membranes JUSTIN HALOOT, SPS — The use of antimicrobial agents began during the 20th century to reduce the effects of infectious diseases. Since the 1990s, antimicrobial resistance has become an ever-increasing global problem. Our laboratory recently found that small antimicrobial peptides (AMPs) have potent antimicrobial activity against a wide range of Gram-negative and Gram-positive organisms including antibiotic resistant organisms. These AMPs are potential therapeutic agents against the growing problem of antimicrobial resistance. AMPs are small peptides produced by plants, insects and animals. Several hypotheses concede that these peptides cause some type of structural perturbations and increased membrane permeability in bacteria however, how AMPs kill bacteria remains unclear. The goal of this study was to design an assay that would allow us to evaluate and monitor the pore forming ability of an AMP, Mastoparan, on model membrane structures called liposomes. Development of this model will facilitate the study of how mastoparan and related AMPs interact with the bacterial membrane.

Friday, October 22, 2010 3:00PM - 6:00PM –
Session AAPT3 Telecommunications and Sound Multidisciplinary Building MS 3.02.14 -
3:00PM AAPT3.00001 Telecommunications and Sound —

Friday, October 22, 2010 3:00PM - 6:00PM –
Session AAPT4 Teaching About Magnets and Magnetism Multidisciplinary Building MS 3.02.16 -
3:00PM AAPT4.00001 Teaching About Magnets and Magnetism —

5:00PM - 5:00PM –
Session FP1 Poster Session (5:00-7:00PM) University Center III Ballroom II, 1st floor -

FP1.00001 Estimating Ultraviolet Solar Irradiance from Total Solar Irradiance: A Nine City Comparison EUGENE CLARK, Trinity University — This paper presents new empirical equations that estimate hourly solar ultraviolet irradiance from the measured total solar irradiance and the solar zenith angle. These equations are based on data taken in 4 US cities (San Antonio, TX, Atlanta, GA, Albany, NY and Fairbanks, AK). Data taken in all 4 of these US cities utilized Eppley model PSP and TUVR radiometers. The response of the TUVR is dominated by UVA, but also includes some of the UVB region of the spectrum. The empirical equations based on the US data are compared with previously published equations based on data measured in 4 cities in Spain and one city in northern China. In all nine cities, the UV fraction of the total solar irradiance increases from about 4% under cloud free conditions to about 8% under heavily overcast conditions.

FP1.00002 Generalized Quaternion Quantum Electrodynamics from Ginzburg-Landau-Schrodinger type Equation V. CHRISTIANTO, SciPrint.org, FLORENTIN SMARANDACHE, University of New Mexico, Gallup Campus — Despite incomparable achievement of Quantum Electrodynamics and its subsequent theories, there are some known limitations and unsolved theoretical problems until this time, including “renormalization” condition and its generalization to larger systems. While renormalization problem has been declared as “settled,” yet it is known for their own founding fathers (Feynman & Dirac, for instance) this question remains unsolved satisfactorily. Other known problems include limitation to explain anti-hydrogen phenomena, and confinement problem in quantum chromodynamics theory.

FP1.00003 Quantum diffusion in optical lattices TAYLOR BAILEY, CARLOS BERTULANI, Texas A&M University-Commerce, EDDY TIMMERMANS, Los Alamos National Laboratory — We study quantum diffusion in optical lattices. After an initial transient, atoms diffuse thought the lattice with a non-linear dependence on the lattice parameters. We demonstrate these results through numerical work on one-dimensional and three-dimensional solution of the time-dependent wave equation. We provide an analytical insight of the diffusion time on the lattice parameters. Furthermore, we present a applications to experimental results.
FP1.00004 Modeling Laser-Tissue Interactions: Implementing Thermal Models and the Wave Equation to Simulate Photon Transport in Tissues1. FREDERICK BARRERA, DHIRAJ SARDAR — The tracking of photons through turbid media (e.g., tissues) has been studied extensively from an experimental vantage point. In addition, myriad computational techniques have also been developed to simulate the interaction of light with tissues. These tissues are difficult to characterize—since their components are exceedingly variegated—and thus present many challenges to clinicians who require models which precisely predict the location and time evolution of energy deposition. Furthermore, the interaction of the turbid media sample with the source of radiation typically involves many dynamic mechanisms (e.g., mechanical, photochemical etc.) Indeed, under certain dynamic conditions, optical properties (e.g., index of refraction, absorption coefficient etc.) are not constant. Using models of thermal distribution, and accounting for an incident source of electromagnetic radiation an analysis may be performed. The differential equations describing these processes may be solved numerically using a finite element technique.

1This work was funded by NIH/NIGMS MBRS-RISE GM60655.

FP1.00005 Photophysical Study of Novel Perylene Analogues for Biophysical Applications1. JORGE PALOS-CHAVEZ, Department of Physics and Astronomy, UT San Antonio, MARK PENICK, Department of Chemistry, UT San Antonio, ROLANDO VALDEZ, University of Texas Southwestern Medical Center, GEORGE NEGRETE, Department of Chemistry, UT San Antonio, LORENZO BRANCACOLEN, Department of Physics and Astronomy, UT San Antonio — Perylene and perylene derivatives have been shown to be useful in a variety of photoinitiated applications, such as molecular dyes, organic solar cells, etc. Recently we started the characterization of novel 3,9-perylene analogues which could potentially lead to the synthesis of novel molecules with improved ability to separate charges. We have characterized the basic photophysical properties of these molecules, and we are currently investigating the photochemistry that leads to photoproducts in chlorinated compounds. Spectroscopic measurements show the substantial changes in photophysical parameters consistent with the conversion of the original compounds into photoproducts. SEM and AFM imaging show that these photoproducts form ordered particles. Mass spectrometry studies have confirmed the presence of these photoproducts as well.

1Supported by NIH/NIGMS MBRS RISE GM-60655.

FP1.00006 Characterization of Rare Earth Oxide/Gold Composites Synthesized by Control of Surface Composition, ZANNATUL YASMIN, ROBERT DENNIS, DHIRAJ SARDAR, MAOGEN ZHANG, WALDEMAR GORSKI, KELLY NASH, University of Texas at San Antonio — The need for novel nanosized biosensors has resulted in increase interest in nanocomposites. The challenge in development of materials is that they should offer robust and tunable characteristics (fluorescence, magnetic, thermal behaviors, etc.) while remaining biocompatible. In this study, we use small molecules to attach transition metal nanostructures (gold spheres) to the surface of rare earth oxide (Er3+:Y2O3) particles synthesized by a urea precipitation method. The goal is to enhance the fluorescence of the rare earth materials through surface plasmons resonance generated by the gold structure while achieving dispersibility of the particles. The attachment of gold nanoparticles (Au NPs, ~20 nm) to the surface of rare earth nanoparticles (RENP, ~100 nm) is achieved by the surface modification with (3-Mercaptopropyl) trimethoxy-silane (MPTS); the average numbers of Au NPs per RENP is controlled by the composition of MPTS and Propyltrimethoxysilane (PTMS, without functional groups). Characterization of the physical properties is performed by Fourier transform infrared spectroscopy and scanning electron microscopy. Fluorescence spectroscopy is used to compare the radiative decay rates of nanocomposites to unmodified particles. The resulting structures will be used in studies of bulk and particle polymer composites for potential biosensing and drug delivery applications.

FP1.00007 Ultra fast response of arrayed waveguide gratings: a phenomenological quantum approach. DANIEL DOMINGUEZ, Texas Tech University, JOHN SANDY, Texas Tech University, LUIS GRAVE DE PERALTA, Texas Tech University — Using a phenomenological quantum description of the ultra fast response of arrayed waveguide gratings (AWG) illuminated with relatively intense short pulses of light, we show that integrated-optics pulse shapers based on AWGs can be used to produce interference between femtosecond pulses of light in conditions where the which-path information is available. We discuss the implications of this result for the Heisenberg uncertainty principle.

FP1.00008 Optical losses and wave-front distortions in the reflection of light from a photonic-crystal mirror, TRAVIS MILLER, SERGIO CANTU, VOLKER QUETSCHKE, MALIK RAKHMANOV, Department of Physics, University of Texas at Brownsville, YI-CHEN SHUAI, DEYIN ZHAO, WEIDONG ZHOU, Department of Electrical and Computer Engineering, University of Texas at Arlington — The photonic crystal mirror, based on patterned silicon nanomembrane technology, promises many applications because of its very high reflectivity at 1550 nm wavelength. We determine the reflectivity and optical losses of a such a mirror using resonant Fabry-Pérot cavity and measuring its line width. We also investigate the wavefront distortions caused by the photonic crystal pattern on the mirror with a Michelson interferometer by interfering the beam reflected from the mirror with a reference beam with an ideal wavefront. In both experiments we incorporate rotational degree of freedom to determine polarization dependence of these phenomena.

FP1.00009 Experimental Investigation of the Possibility for Negative Refraction in Si Opals, LILIANA RUIZ-DIAZ, MALIK RAKHMANOV, VOLKER QUETSCHKE, Department of Physics, University of Texas at Brownsville, ANVAR ZAKHIDOV, Alan G. MacDiarmid NanoTech Institute, University of Texas at Dallas — Synthetic opals are photonic crystals made of silica nano-spheres arranged in a FCC crystalline structure. Such opals are believed to possess negative refraction for certain wavelength of light. We propagate two laser beams (405 nm and 705 nm) through opal prisms and measure their angles of refraction. We also use a broadband light source to select several frequencies in the visible range with a diffraction grating. In addition, we study the photonic band gaps in this material. For certain directions of the incident light the opal samples exhibit total reflection due to the existence of the photonic band gap.
FP1.00010 Analyses of the Ultraviolet Spectra of Er$^{3+}$ in Er$_2$O$_3$ and Er$^{3+}$ in Y$_2$O$_3$ 
SREERENJINI CHANDRA, JOHN B. GRUBER, UTSA, GARY W. BURDICK, Andrews University, DHIRAJ K. SARDAR, UTSA — The ultraviolet (uv) absorption spectra of trivalent erbium (Er$^{3+}$), representing transitions to all energy levels below 44500 cm$^{-1}$, have been analyzed for the crystal-field splitting of the manifold multiplets of Er$^{3+}$ (4$f^{11}$) in C$_2$ symmetry cation sites in single-crystal Er$_2$O$_3$ and Er$^{3+}$:Y$_2$O$_3$. A solid solution exists between the two compounds without altering the local symmetry, which allows us to identify the weaker transitions in Er$^{3+}$:Y$_2$O$_3$ from the stronger transitions observed in the uv spectrum of Er$_2$O$_3$. A total of 134 Stark levels representing 30 multiplets have been modeled using a parametrized Hamiltonian defined to operate within the Er$^{3+}$ (4$f^{11}$) configuration. The crystal-field parameters were determined through use of a Monte Carlo method in which 14 independent crystal-field parameters were given random starting values and optimized using standard least-squares fitting between calculated and experimental levels. The consistent agreement between the experimental and calculated Stark levels in both crystals can be very useful for the ongoing research in intensity analyses and magneto-optical studies on these crystals.

1This research was supported by the National Science Foundation Grant No. DMR-0934218.

FP1.00011 Mapping the double-slit diffraction pattern 
RICHARD SELVAGGI, CHARLES ROGERS, CLAY RICHARDSON, Texas A&M University-Commerce — A red laser, movable double-slit, movable micrometer mounted single-slit light block, and CCD were utilized to map out the single and double-slit diffraction patterns between 0 and 30 millimeters. The three dimensional mapping results demonstrate that the double-slit troughs similarly redirect the electromagnetic energy and light particles. The measured alternating path of the electromagnetic energy and light particles in the double-slit diffraction pattern is different than the theoretic path of light waves defined by destructive interference and indicates that theoretical light waves do not always have electromagnetic energy. George Monk’s 1937 and Richard Feynman’s 1964 finding of conservation of electromagnetic energy in the double-slit light experiment present the following questions: 1) What are the mass-less and energy-less destructive interference light waves found in the double-slit troughs? 2) What force is applied to and what energy is consumed by the work of redistributing the electromagnetic energy and light particles in the double-slit diffraction pattern? 3) Is this unknown force and unknown energy the result of dark matter found in the double-slit troughs?

FP1.00012 A Chandra ACIS Observation of the Pulsar-Wind Remnant RCW 103 
ESTELE JORDAN, ERIC M. SCHLEGEL, University of Texas at San Antonio — We describe spatially-resolved, CCD-resolution spectroscopy of the supernova remnant (SNR) RCW 103 as observed by the Chandra X-ray Observatory during a 19.1 ksec exposure. The outstanding spatial resolution of the Chandra ACIS images resolve diffuse filaments across the remnant, as well as what appear to be explosion fragments, or “bullets,” extending beyond the x-ray bright region in the southwestern part of the SNR. Observed features are soft (E < 3 keV) and we detect evidence of line emissions at several energies. The x-ray bright regions in the southwestern and northeastern part of RCW 103 are consistent with enhancements of optical, infrared, and radio emissions.

FP1.00013 Observations of the 2010 January Outburst of the Recurrent Nova U Scoprius using NASA’s Swift 
MARILYN MOORE, SABRINA ENGELHARDT, LAURA VEGA, LAURA MCMASTER, ERIC SCHLEGEL, UTSA, ASHLEY PAGNOTTA, LSU — We report on X-ray observations of the recurrent nova U Scopii (U Sco) obtained with NASA’s Swift during the 2010 Jan outburst. X-ray spectra were obtained in the 0.1-10 keV band at least once per day throughout the outburst which commenced on 2010 Jan 28 and lasted ~70 days. We fit the spectra with an absorbed, low-order continuum component; the fits yield an integrated X-ray luminosity, the interstellar absorption column, and a pseudo-temperature derived from the continuum parameter. We describe the overall evolution of the X-ray flux as well as the absorption and temperature across the burst.

FP1.00014 Analytical models for the sun1 
JOHN FUQUA, CARLOS BERTULANI, Texas A&M University-Commerce — We investigate analytical models for the sun by fitting the parameters of the models to reproduce the numerical solutions of the hydrostatic equations governing the properties of the sun. The advantage of the analytical models is that they allow a simple description of derived properties such as the neutrino flux.

1Supported by the U.S. DOE and the Research Corporation.

FP1.00015 Numerical Methods for Modeling Cosmic Ray Propagation in the Galaxy 
HUGO ESPEJEL, University of Texas at San Antonio, EDMUND BERTSCHINGER1, Massachusetts Institute of Technology — This work seeks to investigate the trajectories of cosmic ray (CR) particles traveling from a source, like a pulsar or supernova, to Earth. Galactic CRs of moderate energy travel in tightly wound helices around the Galactic magnetic field lines. To better understand how this propagation is affected by errors from numerical integration, a model of the trajectory of a simple harmonic oscillator (SHO) in 2-dimensional phase space is calculated using three algorithms (Euler, Euler-Cromer, and Leapfrog methods). The errors associated with these algorithms are explained using techniques of numerical analysis. Results show that the Leapfrog method converges to the analytic solution of the equations of motion of the SHO the fastest. This method will be used to calculate the trajectory of the Galactic CRs.

1Principal Investigator

FP1.00016 Preliminary Results For the Distribution of Observable Pulsars Within the Galaxy 
FRANK CEBALLOS, MATTHEW BENACQUISTA — We present preliminary results from an attempt to predict the distribution of observable pulsars within the Galaxy. This work is intended to provide some indication of the likelihood of finding a pulsar outside of the Galactic plane. We model the population of pulsars by considering the birth of stars within the disk of the Galaxy and evolving them to the present time. We include a model of the spatial distribution of stars in the disk, the star formation rate, the initial mass function, and the kick velocities given to the neutron star during the supernova event. Following the supernova event, we propagate the neutron star through a model of the Galactic potential to obtain the present-day distribution of pulsars.
Jupiter’s intense magnetic field is second only to the solar magnetic field. This intense field surrounds and permeates a robust magnetospheric plasma that co-rotates with the planet out to several Jovian radii. The distribution of emitting matter is determined by U Sco: if X-rays arise from the proximity of the white dwarf, then we must detect X-ray eclipses and the exact shape of the eclipse is associated with localized plasma injections. When the electrons are separated by pitch angle there is a difference in the longitudinal and local fields that their coronal hole originated in. We have also compared Lee’s prediction of solar wind deflection to observations and found a value of 20°. They also have a mean minimum width of 0.25 AU. At the ecliptic, CIRs do not always form with tilt out of the ecliptic opposing the bulk plasma and magnetic field data. We used this list to study the bulk properties and the three dimensional structure of CIRs using minimum variance analysis. The planar magnetic structure of CIRs form along the Parker spiral and with an approximate, mean tilt out of the ecliptic of 20°. They also have a mean minimum width of 0.25 AU. At the ecliptic, CIRs do not always form with tilt out of the ecliptic opposing the hemisphere that their coronal hole originated in. We have also compared Lee’s prediction of solar wind deflection to observations and found a relationship does exist, but not as expected by theory.

Three Dimensional Structure of CIRs at 1 AU. THOMAS BROILES, UTSA/SwRI — We have studied CIRs at 1 AU over two solar cycles, by identifying 153 CIRs from the start of 1995 to the end of 2008 using ACE and Wind bulk plasma and magnetic field data. We used this list to study the bulk properties and the three dimensional structure of CIRs using minimum variance analysis. The planar magnetic structure of CIRs form along the Parker spiral and with an approximate, mean tilt out of the ecliptic of 20°. They also have a mean minimum width of 0.25 AU. At the ecliptic, CIRs do not always form with tilt out of the ecliptic opposing the hemisphere that their coronal hole originated in. We have also compared Lee’s prediction of solar wind deflection to observations and found a relationship does exist, but not as expected by theory.

Warning times for potentially hazardous long-period comets. SUSAN MARTINEZ, UTSA, SwRI San Antonio, DAN BOICE, WALTER HUEBNER, SwRI San Antonio — Southwest Research Institute and Los Alamos National Laboratory are developing a program to avert collisions of potentially hazardous objects with Earth. Aggressive methods and continuous alertness will be needed to defend against objects with short warning times. In this study we discuss the threat posed by long-period comets. Although relatively rare but large and fast moving, their detection cannot be predicted because of their long orbital periods. For example, Comet C/1983 H1 was discovered on 27 April 1983, and passed Earth at a distance of 0.0312 AU on 11 May 1983. It has an orbital period of 963.22 years. We have developed a database of long-period comets over the last decade that includes dates of discovery, perihelion passage, perigee passage, and the associated distances. We summarize results of anticipated warning times for long-period comets to present nominal and worst-case scenarios for these potentially hazardous objects, given advances in modern telescopic facilities searching for such objects.
is also detected thus exhibiting their usefulness as real world biological markers.

Through comparison with control samples, the optical properties of each component (blood, plasma, and nanoparticles) can be determined. This is the mechanism of the photochemical reaction and unfolding of the protein after irradiation. A combination of various spectroscopic methods is used to characterize the optical properties such as the absorption ($\mu_a$) and scattering coefficients ($\mu_s$) and the scattering anisotropy ($g$). Through comparison with control samples, the optical properties of each component (blood, plasma, and nanoparticles) can be determined individually, thus illuminating any changes due to the biological environment. The emission from the Nd$^{3+}$:Y$_2$O$_3$ particles through the blood is also detected thus exhibiting their usefulness as real world biological markers.

**FP1.00025 Super Storm Dependence upon Solar-Wind-Magnetosphere Coupling**

GEORGE CLARK, University of Texas at San Antonio, JERRY GOLDSTEIN, JOERG-MICHA JAHN, Southwest Research Institute, RADATION BELT STORM PROBE TEAM — Statistical relationships were explored between super geomagnetic storms (Dst < -200 nT) and solar wind parameters. We consider coupling parameters such as the Akasofu epsilon parameter, total energy input into the magnetosphere, Kan and Lee electric field, solar wind electric field, and the IMF components. Correlations between super storms and the solar wind help us understand how energy is transferred into the magnetosphere. Data was obtained using the OMNINWeb data center. OMNINWeb compiles magnetic field and plasma measurements from a suite of spacecraft (ACE, Geotail, Wind, IMP-8, ISEE3) and Dst measurements from the NOAA and Kyoto data hubs. Results show a strong correlation ($r > 0.8$) between the solar wind electric field and IMF components as a function of Dst. Moderate correlations ($r > 0.6$) exist upon the Akasofu epsilon parameter, total energy input, and Kan and Lee electric field with Dst. The total energy input during a super storm is about a factor of two greater than a normal storm and about a factor of six greater in comparison to the solar wind electric field. Results also suggest a natural separation between normal storms and super storms, which suggest different energization mechanisms. Practical applications of this study relate to radiation belt dynamics which threaten our spacecraft and astronauts.

**FP1.00026 Levenberg-Marquardt Algorithm Applied to Cassini-CAPS Corotational Data**

ROBERTO LIVI, University of San Antonio, JERRY GOLDSTEIN, JIM BURCH, ANNA DEJONG, FRANK CRARY, DAVE YOUNG, Southwest Research Institute, San Antonio, FRAN BAGENAL, University of Colorado, Boulder — Plasma corotation flow around Saturn is analyzed using a non-linear, least squares fitting routine based on the Levenberg-Marquardt algorithm, tailored specifically for data from the Cassini Plasma Spectrometer (CAPS). The program assumes the plasma to consist of two species, a light group ($H^+$) and a water group ($H_2O^+$) corotating at the same velocity. It is therefore designed to automatically model a one-dimensional Maxwell-Boltzmann distribution (one for each species) to a large data set and derive the corresponding densities, velocities, and temperatures using minimal computer resources for faster computation. Preliminary results derived by the algorithm are presented for six years of CAPS data, from all longitudes, between 3-10 Saturn radii ($R_S$) and ±10° latitude.

**FP1.00027 Mapping the Galaxy with LISA**

JOSE MCKINNON, MATTHEW BENACQUISTA, UTB/TSC — We have developed a Matlab Fisher MAtrix code in order to study how LISA observations of Galactic compact object binaries can be used to better understand Galactic structure. The code simulates the results of data analysis and estimates the variance and covariance of recovered parameters. We will use the recovered parameters to estimate Galactic structure. Here we present first results applied to a standard Galaxy model.

**FP1.00028 Effect of Porphyrins Bound to Tubulin Dimers**

BRADY MCMICKEN, UTSA — Photosensitizers are photoactive molecules that when irradiated with UV or visible light initiate photochemical or photophysical reactions that may affect the environment surrounding them, including proteins to which they are attached. Our photosensitizers of interest are the anionic porphyrin, mesotetrakis (sulfonatophenyl) porphyrin (TPPS), which bind noncovalently to Tubulin dimers. This is significant since we can then irradiate the porphyrin and cause a change in the geometry of the protein to specifically affect its function. What has yet to be fully understood is the mechanism of the photochemical reaction and unfolding of the protein after irradiation. A combination of various spectroscopic methods can give us insight into the structural changes of the photosensitizer and the protein and characterize the conformational changes produced in the protein. The study is completed by computational simulations of the docking as well as the unfolding of the protein.

**FP1.00029 Chaos Theory and Protein Dynamics**

JAMES BUI, JAMES CLARAGE, University of St. Thomas — Chaos theory, commonly known as the butterfly effect, states that a small change in a complex system may cause large changes in the system as time moves forward. This phenomenon was first discovered by Henri Poincare in the 1880’s. The computer programs NAMD, VMD (Visual Molecular Dynamics) and Mathematica were used to calculate the movements and graphically analyze the trajectories of the protein ubiquitin. A small change was applied to a single atom’s initial position in the x-coordinate to see how it would affect the future dynamics and trajectory of the protein. Our findings indicate an exponential divergence from the controlled trajectory with a Lyapunov exponent = 10.5 [1/ps]. In other words after less than a picosecond (trillionth of a second) the dynamics of a small biophysical system is no longer predictable, even though the underlying Newtonian physical laws are completely deterministic.

1We thank the Welch Foundation for their support of this work, and the Department of Education (CCRRA-HSI Award).

**FP1.00030 Near Infrared Optical Properties of Whole Human Blood and Blood Containing Nanoparticulates**

LAWRENCE C. MIMUN, BRIAN YUST, KELLY L. NASH, DHIRAJ K. SARDAR, University of Texas at San Antonio — Whole human blood is optically characterized in the near infrared (NIR) with and without the addition of nanocrystals. The optical properties were obtained using the double-integrating sphere technique at the Nd excitation wavelength of 808 nm. Y$_2$O$_3$ and Nd$^{3+}$:Y$_2$O$_3$ nanoparticles were added in predetermined amounts to water, blood plasma, and whole blood samples, from which a computational analysis was conducted using the Kubelka-Munk calculational method, the Inverse Adding Doubling Method, and the Magic Light Monte Carlo Method to characterized the optical properties such as the absorption ($\mu_a$) and scattering coefficients ($\mu_s$) and the scattering anisotropy ($g$). Through comparison with control samples, the optical properties of each component (blood, plasma, and nanoparticles) can be determined individually, thus illuminating any changes due to the biological environment. The emission from the Nd$^{3+}$:Y$_2$O$_3$ particles through the blood is also detected thus exhibiting their usefulness as real world biological markers.

**FP1.00031 How Do Single Point Mutations Impact Protein Folding in Parkinson’s Disease**

OLIVIA WISE-SCIRA, ANDREW ROQUE, LIANG XU, ORKID COSKUNER, University of Texas at San Antonio — Although the structures of the wild type (WT) and mutants (A53T, A30P, E46K) of $\alpha$-synuclein ($\alpha$-syn) proteins related to Parkinson’s disease have been studied extensively using both experimental and theoretical tools, the relationships between the structural properties and thermodynamic preferences at a molecular level with dynamics are unknown. Such an understanding is required for accessing detailed knowledge regarding to the “early aggregation and monomer” hypothesis in Parkinson’s disease. We investigated the impact of these single point mutations on the structures and conformational preferences of $\alpha$-syn monomers in aqueous solution as well as the impact of the aqueous solvent environment on the proteins. Obtained qualitative and quantitative results provide new insights into the structure-function relationships of these proteins and help us to understand the molecular mechanism hidden behind the “early aggregation and monomer” hypothesis. Our results show that the tertiary structure of the $\alpha$-syn proteins varies significantly with dynamics, however, this variability is not easily reflected in the changes of the relative amounts of the secondary structural components. The obtained structures also demonstrate that a single point mutation can have a significant effect on protein folding. The structures of each of the WT, A53T, A30P, and E46K $\alpha$-syn monomers differ from each other throughout and the presence of aqueous solution significantly impacts the $\alpha$-syn protein structures.
The maximum solubility of cholesterol in POPC/POPE lipid mixtures. SERKAN BALYIMEZ, JUYANG HUANG, Texas Tech University — Cholesterol is a major constituent of cell membranes and has many important cell functions. The maximum solubility of cholesterol in a lipid bilayer is the highest mole fraction of cholesterol that can be incorporated into a lipid bilayer before cholesterol crystals precipitate. The maximum solubility can provide valuable information about cholesterol-phospholipid interaction. In this study, the maximum solubility of cholesterol in mixtures of POPE/POPC lipid bilayer has been investigated systematically using a cholesterol oxidase (COD) reaction rate assay. The maximum solubility of cholesterol was determined to be 67 mol% in POPC bilayers and 50 mol% in POPE bilayers. In mixtures of POPE/POPC, the maximum solubility of cholesterol increases linearly as a function of the ratio POPE/POPC. The data indicates that cholesterol prefers the large headgroup lipid (POPC) over the small headgroup lipid (POPE) and the maximum solubility increases with the population of large headgroup lipid (POPC), which are consistent with the Umbrella Model. Previously, it has been suggested that cholesterol may form a “hexagonal” regular distribution pattern at the maximum solubility limit in POPE bilayers and a “maze” pattern at the maximum solubility in POPC bilayers. It is still unclear whether domains of these patterns exist at the maximum solubility limit in POPE/POPC mixtures, and more investigation is needed.

FP1.00032 The Maximum Solubility of Cholesterol in POPC/POPE Lipid Mixtures

FP1.00033 Mining X-ray diffuse scattering images for evidence of protein dynamics, STEVEN SOLIS, ANDREA HOLLAND, GERRY WADE, Southwestern University — The detection and identification of bacteria in blood samples is crucial for treating patients suspected of having a blood infection. Current hospital methods for pathogen detection are time-consuming processes with multiple steps. This project’s goal was to develop an efficient biomedical device to detect bacterial growth in blood samples, based on Gerald J. Wade’s 1979 invention (US patents 4250266 and 4267276). Detection was accomplished using a system of electronics to examine the change in the electrochemical properties of a sample in response to bacterial growth, by measuring the sample’s electrical charging and charge dispersion characteristics. After initial trials, it was found that a sample yielded consistent voltage measurements of approximately 100 millivolts prior to any detectable microbial growth. The first species tested, *Escherichia coli*, was detected 11.7 hours after its inoculation in a culture bottle at a concentration of approximately 5-10 organisms per milliliter. In future tests, it is expected that detection times will vary in proportion to the growth rate of each species.

FP1.00034 Dynamics of Small Peptides: Comparison of NMR Relaxation Experiments with Molecular Dynamics Simulations, STEIGER, JAMES CLARAGE, University of St. Thomas — Understanding biological molecules from differing perspectives and obtaining results which concur with one another has been a goal of researchers for years. We applied both theoretical and experimental approaches to study the biophysics and dynamics of a small biological molecule, the dipeptide Alanine-phenylalanine (Ala-Phe). For our theoretical approach we used the computer programs NAMD and VMD to place the dipeptide in a box of water and simulate atomic motions for every atom in the system for 100 nanoseconds. From these simulations we can predict correlation times for the atomic movements. Experimentally, relaxation times (T1, T2) were collected using Nuclear Magnetic Resonance (NMR). Comparing theory with experiment, we found similarities in the trends of correlation times for various atoms in the molecule.

FP1.00035 Light Scattering as an Indicator of Protein Aggregate Size, JEREMIAH BABCOCK, University of Texas at San Antonio, ROLANDO VALDEZ, LORENZO BRANCALEON, University of Texas at San Antonio — Biophysical studies have shown that solutes like proteins undergo aggregation through specific pathways that often lead to long polymeric structures called fibrils. The knowledge of the size of early-stage protein aggregates (oligomers) has an important bearing on the elucidation of the dynamics of the process of protein unit combinations. In this study, bovine serum albumin, a well-characterized model protein known to polymerize in alkaline conditions in the normal (N) to basic (B) was incubated at pH 9.0 for longer than eight days. Particle growth in solution was monitored by resonance and non-resonance light scattering in absorption spectroscopy, and concurrently measured by tapping mode atomic force microscopy (AFM) methods to yield BSA oligomer size distributions through the growth lag phase of elongated fibrils. Results show that BSA concentrated to one mg/mL rapidly forms spherical aggregates, which preferentially come together to form flexible polymers with periodic structures.

FP1.00036 Automated Microorganism Detector, PELHAM KEAHEY, WILL HARDY, MASON CRADIT, STEVEN SOLIS, ANDREA HOLLAND, GERRY WADE, Southwestern University — The detection and identification of bacteria in blood samples is crucial for treating patients suspected of having a blood infection. Current hospital methods for pathogen detection are time-consuming processes with multiple steps. This project’s goal was to develop an efficient biomedical device to detect bacterial growth in blood samples, based on Gerald J. Wade’s 1979 invention (US patents 4250266 and 4267276). Detection was accomplished using a system of electronics to examine the change in the electrochemical properties of a sample in response to bacterial growth, by measuring the sample’s electrical charging and charge dispersion characteristics. After initial trials, it was found that a sample yielded consistent voltage measurements of approximately 100 millivolts prior to any detectable microbial growth. The first species tested, *Escherichia coli* (*E. coli*), was detected 11.7 hours after its inoculation in a culture bottle at a concentration of approximately 5-10 organisms per milliliter. In future tests, it is expected that detection times will vary in proportion to the growth rate of each species.

Support for this project was provided by the King Creativity Fund.

FP1.00037 A Study of the Accuracy and Precision Among XRF, ICP-MS, and PIXE on Trace Element Analyses of Small Water Samples, SAHIL NAIK, RITISH PATNAIK, VENKATA KUMMARI, LUCAS PHINNEY, MANGAL DHOOBHADEL, University of North Texas - Physics, AARON JESSEPH, WILLIAM HOFFMANN, GUIDO VERBECK, University of North Texas - Chemistry, BIBHUDUTTA ROUT, University of North Texas - Physics — The study aimed to compare the viability, precision, and accuracy among three popular instruments - X-ray Fluorescence (XRF), Inductively Coupled Plasma Mass Spectrometer (ICP-MS), and Particle-Induced X-ray Emission (PIXE) - used to analyze the trace elemental composition of small water samples. Ten-milliliter water samples from public tap water sources in seven different localities in India (Bangalore, Kochi, Bhubaneswar, Cuttack, Puri, Hospet, and Pipili) were prepared through filtration and dilution for proper analysis. The project speculates that the ICP-MS will give the most accurate and precise trace elemental analysis, followed by PIXE and XRF. XRF will be seen as a portable and affordable instrument that can analyze samples on-site while ICP-MS is extremely accurate, and expensive option for off-site analyses. PIXE will be deemed to be too expensive and cumbersome for on-site analysis; however, laboratories with a PIXE accelerator can use the instrument to get accurate analyses.

Support for this project was provided by the King Creativity Fund.
FP1.00038 Structural and Thermodynamic Properties of Amyloid-β Peptides: Impact of Fragment Size  
T. KITAHARA, O. WISE-SCIRA, O. COSKUNER — Alzheimer’s disease is a progressive neurodegenerative disease whose physiological characteristics include the accumulation of amyloid-containing deposits in the brain and consequent synaptic and neuron loss. Unfortunately, most widely used drugs for the treatment can palliate the outer symptoms but cannot cure the disease itself. Hence, developing a new drug that can cure it. Most recently, the “early aggregation and monomer” hypothesis has become popular and a few drugs have been developed based on this hypothesis. Detailed understanding of the amyloid-β peptide structure can better help us to determine more effective treatment strategies; indeed, the structure of Amyloid has been studied extensively employing experimental and theoretical tools. Nevertheless, those studies have employed different fragment sizes of Amyloid and characterized its conformational nature in different media. Thus, the structural properties might be different from each other and provide a reason for the existing debates in the literature. Here, we performed all-atom MD simulations and present the structural and thermodynamic properties of $A_{β1-16}$, $A_{β1-29}$, and $A_{β1-42}$ in the gas phase and in aqueous solution. Our studies show that the overall structures, secondary structures, and the calculated thermodynamic properties change with increasing peptide size. In addition, we find that the structural properties of those peptides are different from each other in the gas phase and in aqueous solution.

FP1.00039 Structure, function and folding of phosphoglycerate kinase are strongly perturbed by macromolecular crowding  
ANTONIOS SAMIOTAKIS, University of Houston, APRATIM DHAR, SIMON EBBINGHAUS, LEA NIENHAUS, University of Illinois, DIRAR HOMOUZ, University of Houston, MARTIN GRUEBELE, University of Illinois, MARGARET CHEUNG, University of Houston — We combine experiment and computer simulation to show how macromolecular crowding dramatically affects the structure, function and folding landscape of phosphoglycerate kinase (PGK). Fluorescence labeling shows that compact states of yeast PGK are populated as the amount of crowding agents (Ficol 70) increases. Coarse-grained molecular simulations reveal three compact ensembles: C (crystal structure), CC (collapsed crystal) and Sph (spherical compact). With an adjustment for viscosity, crowded wild type PGK and fluorescent PGK are about 15 Ficol or more active in 200 mg/ml Ficol than in aqueous solution. Our results suggest a new solution to the classic problem of how the ADP and diphosphoglycerate binding sites of PGK come together to make ATP: rather than undergoing a hinge motion, the ADP and substrate sites are already located in proximity under crowded conditions that mimic the in vivo conditions under which the enzyme actually operates.

FP1.000040 An approach for detecting low frequency non-stationarity present in LIGO science data  
ROBERT STONE, University of Texas-San Antonio, SOMA MUKHERJEE, University of Texas-Brownsville, LIGO COLLABORATION — One of the important detector characterization issues in gravitational wave (GW) searches is the seismic background. “NoiseFloorMon” is a data monitoring tool (DMT) that has been developed to help characterize the effect of seismic activity on the gravitational wave channel. The DMT uses time-frequency visualization methods of both the GW channel and seismic channels involved. These events are also compared with existing figures of merit in order to find further correlations with other possible sources across the detector and in the environment. The method is illustrated with data from the fourth LIGO science run.

FP1.000041 Surface chemistry of functionalized carbon nanotubes and their nanocomposites  
Z.P. LUO, L. CARSON, A. OKI, L. ADAMS, N. SOBOYEJO, E.G.C. REGISFORD, A. HOLZENBURG, TEXAS A&M UNIVERSITY TEAM, PRAIRIE VIEW A&M UNIVERSITY COLLABORATION — Carbon nanotubes (CNTs) have been well recognized as a promising material due to their extraordinary mechanical, thermal and electrical properties for diverse applications. However, their behavior of hydrophobicity and chemical inertness, which cause tangles or bad dispersion, limits their commercial applications. In order to overcome the problem of tangle caused by CNT intrinsic van der Waals forces during the composite fabrication, a chemical functionalization process was introduced to achieve a better degree of dispersion, which is a critical factor determining the composite performance. This work is on the characterization the functionalized CNTs and their nano composites using advanced analytical transmission electron microscopy (TEM), including scanning TEM and energy dispersive spectroscopy for chemical compositional analysis using nanometer sized electron beam, electron energy-loss spectroscopic elemental mapping, and electron tomography for 3D reconstruction. It was found that the functionalized CNTs showed better chemical bonding with matrices in the nanocomposites.

FP1.000042 Enhancing Optical Anisotropy and Thermal Stability of Liquid Crystals by Nanoparticles  
KAREN VARDANYAN, ROBERT WALTON, RICHARD JIMENEZ, Rutgers-Camden — The proper electro-optical performance of devices utilizing Liquid Crystal materials require high optical/dielectric anisotropy, low threshold voltage, fast switching, and high thermal stability. Among these devises are liquid crystal displays, guided-wave switches for wavelength division multiplexing, etc. One can tailor LC material parameters for a particular application by using chemical synthesis or mixing several LC materials. However, in the most cases, enhancing one parameter can cause the other parameters to change as well and mostly in undesirable direction. For instance, increase of dielectric anisotropy of the materials usually causes increase in the threshold voltage and switching times. Moreover, in many cases the enhancement process accompanies with decrease in the thermal stability of the materials. We obtained novel binary mixtures of certain type nematic LC with gold nanoparticles. We found that at certain concentrations of gold the dielectric anisotropy, i.e. birefringence, of LC materials increase twice, while the threshold voltage and switching time remain low. More importantly, at the same concentrations of gold the thermal stability of the materials increases in about 15 degrees of Celsius.

FP1.000043 Apparatus for the analysis of surfaces in gas environments using Positron Spectroscopy  
SUMAN SATYAL, LAWRENCE LIM, VIBEK JOGLEKAR, SUSHANT KALASKAR, KARTHIK SHAstry, ALEX WEISS — Positron spectroscopy performed with low energy beams can provide highly surface specific information due to the trapping of positrons in an image potential surface state at the time of annihilation. Here we describe a spectrometer that will employ differential pumping to enable us to transport the positrons most of the way from the source to the sample under high vacuum and then to traverse a thin gas layer surrounding the sample. The positrons will be implanted into the sample at energies less than ~10 keV ensuring that a large fraction will diffuse back to the surface before annihilation. The Elemental content of the surface interacting with the gas environment will then be determined from the Doppler broadened gamma spectra. This system will include a time of flight positron annihilation induced Auger spectrometer (TOF-PAES) which correlates with the Doppler measurements at lower pressures.

1The Welch Foundation Y-1100, NSF DMR 0907679
FP1.00044 Sharma and Fulde-Farrell-Larkin-Ovchinnikov states in an optical lattice. ZLATKO KOINOV, Department of Physics & Astronomy, UTSA, San Antonio, TX, USA; RAFAEL PEREZ, MAURICIO FORTES, Institute of Physics, UNAM, Mexico — We study an imbalance mixture of atomic Fermi gas of two hyperfine states loaded into an optical lattice. We solve the self-consistent equations for the filling factors and the gap equation to investigate the existence of Sharma and Fulde-Farrell-Larkin-Ovchinnikov (FFLO) superfluid states assuming a contact interaction between the atoms (Hubbard model). The order parameter in the case of Fulde-Farrell-Larkin-Ovchinnikov (FFLO) superfluid is chosen to be \( \Delta_n = \Delta_0 \exp(iq \cdot r) \), where \( 2q \) is the pair momentum in a single plane wave FFLO state.

FP1.00045 A first principles study of noble metal-doped silicon nanocrystals \( \text{Si}_{n-1}M \) (\( n = 75 \) and 150 and \( M = \text{Cu}, \text{Ag}, \text{Au} \)). CEDRIC MAYFIELD, MUHAMMAD HUDA, Department of Physics, University of Texas Arlington — Silicon nano-structures can have important roles in many useful applications, such as in nano-scale energy conversion materials, as nano-detectors of gas particles or as thermoelectric materials. To achieve efficient performance of these nano-devices, electronically tailored nano-structures are needed. For this a thorough understanding of both doped and undoped nano-structures is essential. Here we will present results of our first principles spin polarized electronic structure calculations of noble metal doped silicon nanocrystals using a hybrid density functional theory model (B3LYP-DFT) and a LanL2DZ basis set. The nanocrystals are studied here as a test group, and are based on three different isomers of bulk silicon: diamond, wurtzite, and BC8. Geometry optimizations of the pure \( \text{Si}_n \) nanocrystals were performed for spin magnetic moments of \( s=0 \mu_B \) and \( s=2 \mu_B \) for each isomer. Then the substitutional doping of M atom was done separately at the inside and at the surface of the nanocrystals. The doped nanocrystals’ geometries were also optimized for spin magnetic moments \( s=1 \mu_B \) and \( s=3 \mu_B \). For the bigger nanocrystals, the energy differences between the two spin states are very small. Binding energies and HOMO-LUMO gaps were calculated and a comparative analysis of the pure and doped silicon nanocrystals will be presented.

FP1.00046 Photocatalytic Decomposition of Water: Next Generation Fuel Source. KEEGAN HANKS, UTSA — Photocatalysis of hydrogen from water has been vastly concerned with using a Pt/Ru co-catalyst for the generation of hydrogen from water and molecular co-catalysts with hydrocarbon precursors. This process contains separate nucleation sites and proved to have a limited efficiency. Molecular and nanoparticle co-catalysts have also been considered showing an improvement in the applicability of this water-splitting process to produce a clean and renewable fuel process. Recent research has vastly improved the feasibility of the nanocatalyst co-catalyst based process as a clean and reliable resource for fuel. I present herein a theoretical application of composite nanoparticles using transition metal semiconductors. I propose the composite nanostructures as the catalyst and the co-catalyst in one nanoparticle rather than an expensive Pt co-catalyst and molecular catalyst combo. With this approach, our goal is to develop a single beaker synthesis of these nanoparticles and place them in water under artificial sunlight in our newly developed laboratories here on campus to characterize the nanoparticles and analyze the efficiency of hydrogen generation.

FP1.00047 Study of Bulk Modulus in Zinchenlende Nitrogen doped Gallium Phosphide Alloys Using Density Functional Theory. BRANDON BUTLER, MUHAMMAD HUDA, Department of Physics, University of Texas Arlington — Solar energy is seemingly the most attractive prospect in renewable energy technology. The problem arises in the ability to convert and store this source of energy into usable electrical energy. Development of solar cell materials has become an object of focus among scientists. In this work, a theoretical analysis will be employed to study the elastic properties, namely bulk modulus, and its’ first pressure derivative \( B_0' \) of \( \text{Ga}_x \text{P} \) alloys doped with \( \text{N} \). The total energy as a function of the nitrogen concentration of each system has utilized the principles of density functional theory (DFT) and its’ generalization gradient approximation (GGA). Once the total energy calculation was performed, we obtained the bulk modulus, \( B_0 \), and its first pressure derivative, \( B_0' \), by fitting the Birch-Murnaghan equation of state. The bulk modulus was calculated for a few extensively studied materials, namely GaN and un-doped GaP. The results of these prototype calculations compared well with the published experimental values as well as other GGA calculated values. Our computational method of determining the bulk modulus was then used for the \( \text{GaP}_{1-x} \text{N}_x \) alloy with varying concentrations of nitrogen. The bulk modulus for these alloys was found to be notably higher than un-doped GaP and further increases with higher concentrations of nitrogen.

FP1.00048 Study of novel configuration of columnar defects in the high temperature superconductor \( \text{YBa}_2\text{Cu}_3\text{O}_7 \). LAUREN DORSETT, ANDRA TRONCALLI, Austin College, LISA PAULUS, Western Michigan University, WAI -K KWOK, Argonne National Laboratory, AUSTIN HOWARD, NICHOLAS CORNELL, ANVAR ZAKHIDOV, University of Texas Arlington — Columnar defects have proven to be highly effective at pinning vortices in high temperature superconductors. However, most studies have been performed with the defects oriented either perpendicular or at large angles relative to the superconducting Cu-O planes. Our study is novel due to the introduction of defects parallel to the superconducting planes. We will discuss the effect of the defects on the vortex pinning anisotropy of the \( \text{YBa}_2\text{Cu}_3\text{O}_7 \) single crystals.

1This work was supported through the Cottrell College Science Award 7723, provided by the Research Corporation for Science Advancement.

FP1.00049 Temperature Dependencies of Linewidths, Positions, and Line Shifts of Spectral Transitions of Trivalent Neodymium Ions in Ceramic Nd3+:Y2O3. FRANCISCO PEDRAZA, EDWARD KHACHATRYAN, ROBERT DENNIS, KELLY NASH, DHIRAJ SARDAR, The University of Texas at San Antonio — Effects of temperature on widths and shifts of the spectral lines of Nd\(^{3+}\) in \( \text{Y}_2\text{O}_3 \) polycrystalline ceramic have been investigated. The spectral lines corresponding to the inter-Stark transitions \( R_1 \rightarrow Y_1 \) (1074 nm) and \( R_1 \rightarrow X_1 \) (914 nm) within the \( ^4F_3/2 \rightarrow ^4I_{11/2} \) and \( ^4F_3/2 \rightarrow ^4I_{1/2} \) transitions, respectively, have been studied. The widths of these lines and their shifts have been measured as a function of temperature in 10K-300K range. The spectral linewidths of both transitions are found to increase with increasing temperature. This research was supported by the National Science Foundation Grant No. DMR-0934218.
Data in Aluminum using a Strontium-90 Source, SAMANTHA EVERETT, Texas Southern University — A disagreement is still under investigation. The measured data and simulated curves were comparable; however, a discrepancy in the relative count rates was observed. The origin of this discrepancy is under investigation.

To ensure the validity of our measurements, linear extrapolation techniques were employed to determine the in-medium beta particle range from standard and low-energy electromagnetic physics models, and using the radioactive decay module for the electrons primary energy distribution. A simulation of the experimental setup using the Geant4 Monte Carlo toolkit (version 9.3). The purpose of this study was to benchmark our measurements against theoretical predictions.

An increase in oxygen atmosphere to 250mTorr, resuming deposition for 59min. The third film was deposited under HV at 200°C for 1 min, the oxygen atmosphere and temperature were then set to 250mTorr and 850°C followed by film deposition for an additional 59min. All three samples were annealed at 840°C for 15 min and lowered to 20°C at a rate of 3°C per min. Hysteresis measurements were obtained for the samples with a Radiant Technologies inc. RT6000HVS system. It was observed that both the first and second films had a hysteresis loop in close resemblance to paraelectric materials while the third film showed an improved square shape hysteresis loop, indicative of ferroelectric properties.

Capturing the Potential of Dye-Sensitized Solar Cells, JAMES BENSON, University of Texas at San Antonio — Dye-sensitized solar cells are a continually developing type of low-cost solar cells that have commercial efficiency around 5-10%. The proposed research here will be focusing on the photo-blooming and improving techniques for electron transport. Nature has given us a goal to reach towards with proven techniques for converting light into energy with around 30-40% efficiency, however, chlorophyll, the light absorber in plants, is expensive and it is not practical to make solar cells with only chlorophyll as the absorber. One such alternative to chlorophyll is phthalocyanines which is a common industrial dye used in many applications. This dye has a common similar ring without the long phyto chain that chlorophyll has. Previous research has shown that encapsulating organic dyes can magnify the properties of dye from the increased concentration with a possible benefit of stabilizing the dye allowing it to slow down the photo bleaching significantly. Likewise, such encapsulation may help with thermal stability since many dye-sensitized solar cells require a liquid or gel solution that is sensitive to thermal expansion. Many researchers are also finding new ways to encapsulate the dyes or dope the p-n layers with nano and meso tubes to help with electron transport or build the p-n layers right in the tubes. This allows for countless layers and an overall more efficient design.

Study of Narrowband Noise in Gravitational Wave Interferometers, THILINA SHIHAN WEERATHUNGA, University of Texas, Brownsville — Narrowband noise in LIGO (Laser Interferometer Gravitational Wave (GW) Observatory) restricts usability of GW data for astrophysical searches and reduces sensitivity of the searches. Attempts to remove these narrowband noise features in GW data have been in the works for a long time. All the line removing algorithms require a complete list of lines and line information such as central frequency and width of lines, present in the data. The problem with preparation of such a database is the fact that the lines are non-stationary and the non-stationarity of the lines is unpredictable depending on the operating conditions of the instrument and can occur both on a short time-scale as well as on a long time-scale. This work presents a new technique for dynamically identifying and cataloging the narrow band line features present in GW data.

Modeling signals in gravitational wave interferometric data, GAMAGE DANNAN-GODA, University of Texas Brownsville — The current generation of gravitational wave detectors e.g. LIGO (www.ligo.caltech.edu) are taking data in the “science” mode. The data received at the output is a mixture of many different kinds of signals of instrumental and environmental origin (the detector “noise”). This study focuses on how to model these spurious signals so that they can later be subjected to further analysis to classify them into groups. Signals from different instrumental and environmental sources bear different signatures and thus have different waveforms. A low order ARMA can model these signals. The method is demonstrated by application on real data.

Smarandache’s Minimum Theorem in the Einstein Relativistic Velocity Model of Hyperbolic Geometry, CATALIN BARBU, V. Alessandri College, Bacau, Romania — We present a proof to the Smarandache’s Minimum Theorem in the Einstein Relativistic Velocity Model of Hyperbolic Geometry.

Applications of the diffraction and interference of light and electronic waves, CRISTIAN BAHIRM, ROBERT LANNING, Lamar University — As part of a NSF sponsored program, called STAIRSTEP, at Lamar University we are working on improving the basic knowledge of our physics majors in topics with broader impact in various areas of science and engineering [1]. The purpose is to facilitate a deeper understanding of some fundamental concepts in the field of optics through hands-on experience [2]. We choose to study the interference/diffraction of light and matter waves, because of its fundamental importance in physics with many applications. We target multiple goals in our field of study such as to understand the formation of electronic waves (wave packets) and their interaction with atoms in crystals (electron diffraction); the Fourier analysis of light with applications in spectroscopy, etc. We can show that a crystal lattice Fourier transforms the sinusoidal waves associated to free electrons fired toward the crystal. Our studies led to a simple and instructive recipe for discovering atoms in crystals from the analysis of the diffraction patterns produced by radiation or by electrons transmitted through crystals. [1] Doerschuk P. et al., 39th ASEE/IEEE Frontiers in Education Conference, San Antonio 2009, M3F-1. [2] Bahrim C., Innovation 2006 – World Innovations in Engineering Education and Research, Chapter 17, iNEER Innovation Series, ISBN 0-9741252-5-3.

Comparison of GEANT4 Physics Models with Measured Beta Particle Data in Aluminum using a Strontium-90 Source, SAMANTHA EVERETT, Texas Southern University — A transmission curve experiment was carried out to measure the range of beta particles in aluminum in the health physics laboratory located on the campus of Texas Southern University. The transmission count rate through aluminum for varying radiation lengths was measured using beta particles emitted from a low activity (~1 μCi) Sr-90 source. The count rate intensity was recorded using a Geiger Mueller tube (SGC N210/BNC) with an active volume of 61 cm³ within a systematic detection accuracy of a few percent. We compared these data with a realistic simulation of the experimental setup using the Geant4 Monte Carlo toolkit (version 9.3). The purpose of this study was to benchmark our Monte Carlo for future experiments as part of a more comprehensive research program. Transmission curves were simulated based on the standard and low-energy electromagnetic physics models, and using the radioactive decay module for the electrons primary energy distribution. To ensure the validity of our measurements, linear extrapolation techniques were employed to determine the in-medium beta particle range from the measured data and was found to be 1.87 g/cm² (~0.693 cm), in agreement with literature values. We found that the general shape of the measured data and simulated curves were comparable; however, a discrepancy in the relative count rates was observed. The origin of this disagreement is still under investigation.
FP1.00057 Shape-Controllable Synthesis of Gold Nanostructure and Their Application in Surface-Enhanced Raman Scattering (SERS)

JIANHUI YANG, DHIRAJ SARDAR, Department of Physics and Astronomy, University of Texas at San Antonio — Noble metal nanostructures have attracted considerable attentions because of their various applications such as imaging, catalysis, sensing, SERS, diagnosis, and therapy. Shape-control provides an important strategy for designing metallic nanostructures to tailor their physical and chemical properties. Ethylenediaminetetraacetic acid (EDTA), a chelating agent, was used for the controllable synthesis of coral-shaped gold nanostructures in aqueous solution. EDTA serves not only as a reducing agent but also as a particle capping agent in the formation of coral-shaped Au nanostructures. It is found that the concentration and reaction temperature play significant effects on the formation and growth of these novel nanostructures. Moreover, these Au nanostructures show excellent SERS enhancement ability, which could serve as highly sensitive and reproducible SERS substrates for chemical and biological detection.

This work was supported by the National Science Foundation Partnerships for Research and Education in Materials (PREM) Grant No. DMR-0934218.

FP1.00058 Er³⁺:Y₂O₃ Fluorescence Enhancement through Energy Transfer to Plasmonic Nanoparticles

NATHAN RAY, University of Texas San Antonio — Rare earth (RE) and noble metal (NM) hetero-nanostructures hold promise for many unique and robust applications. The overlap of the Er³⁺/H₂S₂ fluorescence manifold with the extinction spectra of the Au surface plasmons can give rise to energy transfer between Er³⁺ (donor) and plasmonic Au (acceptor). In the limit of high efficiency energy transfer, the intensity of emission from the Er³⁺/Au hetero-nanostructure becomes significantly more intense than the emission of Er³⁺ alone. The quantum efficiency of the combined system, in the limit of high energy transfer, is dependent on only the scattering quantum efficiency of the Au nanoparticles. Additionally, this enhancement is a function of the quantity of gold attached. Here, we report and discuss the synthesis and spectroscopic properties of colloidal hetero-nanostructures based on a radiating plasmon model of surface plasmon coupled emission. This research was supported by the National Science Foundation PREM Grant No. DMR-0934218.

FP1.00059 Comparative study of Nd³⁺ in various nanocrystalline sesquioxide hosts (Nd³⁺:RE₂O₃ where RE = Y, Gd, La, Yb, and Sc)

JESSE SALAS, University of Texas at San Antonio, ROBERT DENNIS, KELLY NASH, DHIRAJ SARDAR — Rare earth sesquioxides have obtained much attention for their unique optical properties. Their strong and sharp electronic transitions coupled with their long excited state lifetimes make them favorable candidates for biophotonic applications such as fluorescent biological markers. Neodymium was chosen as the fluorophore for its efficient fluorescence from 860-1200nm. This emission is ideal for deep tissue imaging and sensing as it lies within a wavelength region of minimal attenuation from biotissues. Here we report the synthesis of nanocrystalline Nd₃⁺ doped oxides and consider their phase dependent optical properties. Room temperature absorption of Nd³⁺:RE₂O₃ is reported and analyzed through the Judd-Ofelt (J-O) theoretical model to reconstruct the fluorescence lineshapes and branching ratios of the Nd³⁺ (4F3/2) transitions 3F3/2 → 2F5/2, 2F7/2, 2F9/2, 2F7/2, 2F5/2. Additionally, we report room temperature and 8K fluorescence, excited state lifetimes, and X-ray diffraction as a function of crystal phase.

This research was supported by the National Science Foundation PREM Grant No. DMR-0934218.

FP1.00060 Synthesis and Optical Properties of Nd³⁺ in Nanocrystalline Nd³⁺:BaGd₂O₄

KENNETH RAMSEY, ROBERT DENNIS, JIANHUI YANG, MAOGEN ZHANG, DHIRAJ SARDAR — Rare earth (RE) based spinel structures (BaRE₂O₄), when doped judiciously with trivalent RE ions, are not susceptible to photobleaching, offer many sharp electronic transitions (from the visible to the NIR wavelengths) with excited state lifetimes on the order of milliseconds, and are promising for many applications ranging from high efficiency lighting, solar cells, and biomedical devices. BaRE₂O₄ has hitherto been synthesized on the nanoscale and many of the spectroscopic properties are unknown. Divalent barium, in particular, has been known to sensitize rare earth elements when incorporated into amorphous glasses. Here we report the synthesis and comparative optical properties of nanocrystalline Nd³⁺:Gd₂O₃ and Nd³⁺:BaGd₂O₄. Structural characterization was accomplished by scanning transmission electron microscopy, energy dispersive spectroscopy, and x-ray diffraction. The optical properties of Gd₂O₃ and BaGd₂O₄ were recorded and compared to other well known systems, such as Nd³⁺:Y₂O₃.

This research was supported by the National Science Foundation PREM Grant No. DMR-0934218.

FP1.00061 Silver (Ag) nanostructure assisted fluorescence imaging

KYUNG-MIN LEE, ARUP NEOGI, MINJUNG KIM, BONGSOO KIM, RAFAL LUCHOWSKI, ZYGMENT GRYCZYNSKI, NILS CALANDER, TAE-YOUL CHOI — We developed a novel cell imaging technique using nanoeengineered plasmonic platform which consists of a combined structure of silver (Ag) nanowire (NW) and nanodot (ND) array (NW-ND). This novel platform can be a promising utility for optical imaging and labeling of biological systems. Strongly enhanced fluorescence from fluorophore, mediated by optical resonant field, is attributed to surface plasmon (SP) coupling between Ag NW and NDs. We succeeded in obtaining the fairly enhanced fluorescence intensity and quenched lifetime from LDS798 dye (1-Ethyl-4-(4-(p-Dimethylaminophenyl)-1,3-butadienyl)-quinolinium Perchlorate) dissolved in 0.2% poly(vinyl) alcohole (PVA). This novel nanoengineered Ag NW and NDs. We succeeded in obtaining the fairly enhanced fluorescence intensity and quenched lifetime from LDS798 dye (1-Ethyl-4-(4-(p-Dimethylaminophenyl)-1,3-butadienyl)-quinolinium Perchlorate) dissolved in 0.2% poly(vinyl) alcohole (PVA). This novel platform can be a promising utility for optical imaging and labeling of biological systems.

FP1.00062 Evidence for hexagonal diamond in CVD grown diamond thin films

RAJARSHI CHAKRABORTY, SURESH SHARMA, UT Arlington — Hexagonal diamond, an energetically unfavorable carbon structure, has been of interest, since the first report of its synthesis from crystalline graphite at high pressure and temperature (≥130 kbar and 1000°C).…… The physical properties of this allotrope of carbon are significantly different from those of the cubic diamond. Although, the C-C bonding in both cubic and hexagonal structures is sp³, the stacking sequences are different. Whereas it is “ABCABC…” in the commonly observed cubic structure, it is “ABAB…” in hexagonal diamond. These structures are further characterized by: (i) bond length a = 1.545 Å for cubic diamond and a = 2.52 Å and c = 4.12 Å for hexagonal diamond, (ii) calculated band gaps of 5.6 and 4.5 eV for the cubic and hexagonal structures, respectively, and (iii) relative stability (hexagonal being less stable), hardness (hexagonal is harder than cubic diamond), and different vibrational spectra.…… Based on the SEM and Raman spectroscopy data, we present clear evidence for nanometer size (10-100 nm) hexagonal diamond particles in CVD-grown diamond thin films.……

FP1.00063 Formation and growth of Nanodots and Nanowires in an amorphous matrix.

FP1.00063 Electronic Structure of Bimetallic Core/Shell Quantum-Dots, RUBEN ESTRADA-SALAS, HECTOR BARRON, DEVRAJ SANDHU, MIGUEL JOSE-YACAMAN, University of Texas at San Antonio — A quantum-dot (QD) is a nanoscale structure consisting of one or more semiconducting materials in which the motion of fundamental charge carriers is confined in all spatial dimensions. Core/shell quantum-dots (CSQDs) are a variety of QD consisting of two sections: An ellipsoidal core is manufactured from one material, and a shell of a second material is added around this. QDs have been the subject of great scientific and technological interest, with promising applications that include display devices, biological tagging materials, photovoltaics, and lasers. In this work, the electronic structure of bimetallic CSQDs (size < 2 nm) is analyzed by using Density-Functional Theory (DFT), with the end of correlate their electronic properties with their potential applications. We select the Au/Ag, Au/Pd and Au/Pt systems because of the experimental studies reported on these systems.

FP1.00064 Synthesis and characterization of monodispersed icosahedral Au using spherical aberration correction1, J. JESUS VELAZQUEZ-SALAZAR, RODRIGO ESPARZA, MIGUEL JOSE YACAMAN, UTSA — Monodisperse icosahedral Au nanoparticles were synthesized using one step protocol. The morphology and structural characteristics of the icosahedral Au nanoparticles with uniform size were studied in detail using ultra-high resolution scanning electron microscope (SEM) and a scanning transmission electron microscope Jeol JEM-2010F with an accelerating voltage of 200 kV (resolution 0.19 nm point-to-point) and a scanning transmission electron microscope Jeol JEM-ARM200F (STEM) attachment with a spherical aberration corrector. The average size of the icosahedral Au nanoparticles was 10 nm. STEM Cs-corrected images showed the atomic structure of the nanoparticles, oriented mainly on the five and two fold axes. The nanoparticles were also characterized using UV/vis absorption spectrum.

FP1.00065 Microwave-assisted synthesis and characterization of star-shaped zinc oxide micro and nanostructures, FLOR ESTHELA PALOMAR PEREZ, UTSA, IDALIA GOMEZ DE LA FUENTE, UANL, MIGUEL YACAMAN, UTSA — This work reports the synthesis of star-shaped ZnO nanostructures from Zn(NO$_3$)$_2$ and methenamine by microwave assisted method. The molar ratio of the precursors and microwave power irradiation were the main parameters for the synthesis. XRD shows ZnO in wurtzite structure. SEM images show the presence of star-shaped zinc oxide structures from 300 nm to 3 µm which grew from nanorods. The methenamine proportion in the solution acts as director for the rods production. In the 1:1 molar ratio only star shaped zinc oxide nanostructures were obtained.

FP1.00066 Possible mechanism(s) behind recently observed effects of incorporating gold nanoparticles into a polymer-dispersed liquid crystal2, ALFONSO HINOJOSA, SURESH SHARMA, UT Arlington — Recently we reported that addition of relatively small concentrations of about 14-nm diameter gold nanoparticles (Au NPs) to a polymer-dispersed liquid crystal (PDLC) produces rather large changes in the electro-optical properties of the PDLC. For example, addition of Au NPs to PDLC microstructure lowers its threshold voltage by almost 50% and increases optical transmission in a manner that depends on NPs concentration and applied electric field. In order to understand these observations, we have carried out electro-optical measurements on several PDLCs as functions of the polarization of the incident laser beam and applied electric field. In this presentation, we will discuss the results obtained from these experiments and suggest mechanism(s), which might explain NPs-induced changes in the electro-optical properties of PDLCs.

1Supported, in part, by US Department of Education GAANN grant P200A090284-10.

FP1.00067 Piezoelectric Charging for Smart Fabric Applications, ROSS HACKWORTH, JULIE MORIERA, RAMAKRISHNA KOTA, ROBERT MAXWELL, ARTURO AYON — We report on the feasibility of incorporating flexible poly(vinylidene fluoride), or pVDF, piezoelectric membranes to be used to generate an electrical charge to powering portable electronics. By converting a person’s naturally expended mechanical energy into useful electrical energy, the batteries currently in use in portable electronic devices may be minimized, as well as made efficiently green. Our current research includes an innovative design and fabrication method that integrates a flexible piezoelectric onto clothing similar to previous works, our approach is to build the devices directly onto the fabric allowing for low temperature processes (less than 200 °C). The device will consist of a bottom electrode/wearable fabric, a piezoelectric layer and a top electrode to complete the power generating smart fabric. A membrane 6 µm thick of PVDF is combined with 100 nm sputtered gold electrodes on the outer surfaces to allow for electrode contacts. The contacts are connected to a data collection device, a rechargeable battery, or a capacitor as required for energy storage and evaluation. The electrodes are connected to a DAC system to determine the voltage output. The membrane generates a voltage of approximately 200 mV, with a background noise level of 40 mV.

FP1.00068 Acceleration of H$^-$ ions for the Cyclotron Institute Upgrade Project, JUAN OLVERA, Angelo State University, HENRY CLARK, Texas A&M University — The Cyclotron Institute at Texas A&M University is undergoing an upgrade that will allow for the production of radioactive ions for nuclear physics experiments. These ions will be produced with one of two ion guides, then collected, charge boosted and reaccelerated in the K500 cyclotron. The first radioactive ion beam for the project will be $^{27}$Si (T/τ=4.16s) at 15 MeV/u and will be produced through the reaction $^{27}$Al(p,n)$^{27}$Si with 30 MeV protons. The recently recommissioned K150 cyclotron will accelerate the proton beams to intensity as high as 20 µA in order to produce sufficient amounts of radioactive ions. Rather than using an electrostatic deflector to extract the proton beam from the cyclotron, H$^-$ ions will be introduced into the cyclotron, accelerated to 30 MeV and then stripped to protons with a thin carbon foil at extraction. First tests show the extraction efficiency to be nearly 100% and that the technique greatly reduces interior activation of the cyclotron and problems from secondary radiation. The H$^-$ ion source, injection scheme and results from first tests will be presented.
**FP1.00069** Experimental Verification of Moseley’s Law and the Measurement of Environmental, Pollution, and Biological Samples using X-Ray Fluorescence analysis, VENKATA KUMMARI, University of North Texas, Denton, Texas, SAHIL NAIK, RITISH PATNAIK, Texas Academy of Math and Science, JEROME DUGGAN, BIBHUDUTTA ROUT, University of North Texas, Denton, Texas — X-rays are in general known to follow Moseley’s Law. He provided the first concrete experimental evidence in favor of Bohr’s theory of the atom. His major discovery was that there is a systematic mathematical relationship between the X-ray produced by the target and the atomic number of the target. This relationship became known as Moseley’s Law and just think he was only 25 years old when he made this discovery. Moseley’s Law states that the frequency of the Kα radiation is given by $\nu = \frac{1}{\lambda} = \frac{1}{c} \frac{1}{Z} (Z - 1)^2$ where $c$ is the velocity of light and $R$ is the Rydberg constant. Therefore a plot of the square root of frequency of the Kα line versus the atomic number of the element should be a straight line. A similar plot for the Kβ line also yields a straight line. In this poster we will show the X-ray fluorescence measurement of a variety of environmental, pollution and biological samples. The X-rays from these samples were excited with an X-ray tube and radioactive sources which gives experimental verification of Moseley’s Law and X-ray fluorescence measurement.

**FP1.00070** Constructing the Hodoscope Arrays for the Fermilab E-906/SeaQuest Spectrometer, BRIANNA EDLUND, Abilene Christian University, SEAQUEST COLLABORATION — SeaQuest is a fixed-target experiment designed to extract the light antiquark sea structure of the proton at high Bjorken-x. Using 120 GeV/c protons from the Fermilab Main Injector, the experiment will measure the cross section ratio of di-muon pairs produced by the Drell-Yan process with liquid hydrogen and deuterium targets. From this ratio the light antiquark ratio will be extracted. The trigger for the di-muon pairs uses a set of 8 hodoscope planes, the final four of which are the topic of this work. The final four hodoscope planes consist of 128 scintillator paddles and 224 photomultiplier tubes (PMTs). Due to their size, three planes require PMTs on each scintillator end to avoid timing jitter. SeaQuest uses the old PMTs and tube bases from E866/NeSea, plus other experiments, so it was critical to verify the performance of each PMT and base. These tests included operating voltages, noise rates, and rate capability. The methods used would be presented as well as how the results were used to optimize efficiency in the spectrometer’s expected high-rate regions.

**FP1.00071** Development of a Gas Stopper for Fusion-Evaporation Products, JORDAN SEFCIK, Angelo State University, CHARLES FOLDEN III, MARISA ALFONSO, Texas A&M University — New plans are needed in order to chemically study superheavy elements. According to a design from Michigan State University, implementing a gas stopper is the best way to do this. After being transferred through a Momentum Achromat Recoil Separator (MARS), produced ions of 158Hf eventually reach a variable angle mylar degrader, Reaction Transfer Chamber (RTC) window, which is followed by a gas stopper of helium. Inside the gas cell is a series of electrodes, followed by a funneled “flower petal” design. Using the simulating program SIMION, the electrodes have electric potentials applied to allow the useful particles to enter in order to funnel the ions into a small opening at the end of the gas stopper. Here the ions will undergo certain chemistry experiments in order to learn more about them. The hafnium ions enter the gas stopper with an energy of ~3 MeV. However, when they reach the end of the cell, they must have an energy on the order of 0.1 eV in order perform certain chemistry experiments on them. Using an optimized set of potentials, the survival rate for the simulated ions was 96%. These results are agreeable in the sense that within error bars, there is no room for improvement in extraction efficiency. This set-up also gives desirable results for 251Rf, which is considered a superheavy element and is thought to have the same periodicity as hafnium.

**FP1.00072** Upsilon + Hadron correlations at the Relativistic Heavy-Ion Collider (RHIC), MATTHEW CERVANTES, STAR, STAR COLLABORATION — STAR has the capability to reconstruct the heavy quarkonium states of both the J/Ψi and Upsilon particles produced by the collisions at the Relativistic Heavy Ion Collider (RHIC). The systematics of prompt production of heavy quarkonium is not fully described by current models, e.g. the Color Singlet Model (CSM) and the Color Octet Model (COM). Hadronic activity directly around the heavy quarkonium has been proposed [1] as an experimental observable to measure the radiation emitted off the colored heavy quark pair during production. Possible insight into the prompt production mechanism of heavy quarkonium can be obtained from this measured activity. Using STAR data from pp collisions at $\sqrt{s} = 200$ GeV, the high S/B ratio found in Upsilon reconstruction can enable us to perform an analysis of Upsilon + Hadron correlations. We will present our initial investigation of such an analysis.


**FP1.00073** Development of a Low-Level Counting Station, OMAR MAGANA, SPS — A low-level counting station was developed to determine the half-life of 60Fe. The iron source was selected among other products during the process of nuclear collision. Utilizing a K1900 fragment separator from the NSCL facility at MSU, the 60Fe was produced and implanted into Al Foils. The iron was later extracted by a chemical process and precipitated nucleus as at the Argon National Laboratory. Since, the 60Fe sample serves as a contaminant; the Cobalt was removed in chemistry, to insure all measure 60Co is from the decay of 60Fe. In order to achieve successful results, a low-level counting station was developed to maximize the background suppression using lead bricks. The lead castle was engineered to reduce background radiation that interferes with the detector. By doing so, various calibrations and arrangement of lead bricks were done to add suppression into the counting station. Once the detector shielding was ready, a background run was made in order to compare the difference between the previous shielding that was built last year by other colleagues. In future experiments, the 60Fe sample will be inserted into the detector. The 60Co activity will be measured to determine the half-life of 60Fe.

**FP1.00074** CdSe-ZnS Core-Shell and Gold Quantum Dots and the Effects of Different Substrates, GILBERT BUSTAMANTE, SPS, MOHSEN PURAHMAD, RADE KULJIC, MITRA DUTTA — Over the past 20 years, all areas of nanotechnology have been in a period of intense complexity and using quantum mechanics in order to improve the use of these nanostructures. Quantum dots, nanowires, and nanoparticles are just a few nanostructures used for a wide variety of applications, ranging from electronics, optoelectronics, to diverse biomedical uses. Due to the size of these particles and devices scaling down, we can no longer use classical physics to determine their behavior rather we need to use quantum mechanics. The goal now is to understand these nanostructures in order to use them effectively. Our objective for this project was to view the properties and formations of the layer of Cadmium Selenide, Zinc Sulfide (CdSe-ZnS) core-shell quantum dots when placed on different substrates, Glass, Indium Tin Oxide (ITO), Silicon (Si), and Gallium Arsenide (GaAs) and how Gold quantum dots reacted to substrates at different temperature differences. The CdSe-ZnS quantum dots were prepared in water then dropped cast onto each of the four substrates. Once the solution evaporated, we used Photoluminescence and UV-Vis Absorption Spectroscopy, along with viewing the substrates under a microscope, to investigate if the properties of the quantum dots were different and if the quantum dots formed any particular patterns. The results of the measurements show that the substrates have no significant effects on the quantum dots’ properties but the formation of the quantum dots were different.
FP1.00075 Exploration of Traveling Waves in High Field Magnetic Resonance Imaging, ZACHARY HERNANDEZ, SPS — MRI has been a remarkable means of medical imaging for the last three decades without exposure to ionizing radiation. The increase in MRI signal with the increase of magnetic field strength is the main motive in a move towards imaging at higher field strengths. However, the advent of higher field strength MRI has come with the challenge of maintaining homogeneous excitation fields (B1). One promising solution to this has been to transmit radio-frequency (RF) signals using a patch antenna instead of the usual RF coil. This technique exploits the theory of waveguides and traveling waves typically used in high frequency applications. In this particular study we have investigated this unique application by measuring B1 maps, geometric distortions, and signal-to-noise ratios (SNRs) in order to better quantify its potential in MRI. Using phantoms to match the similar physical features of the human head/torso region, we ran comparative scans using the traveling wave setup versus the conventional head volume coil setup on a Philips 7 Tesla MRI scanner. The goal of this experiment was to systematically measure B1 maps for flip angle efficiency and multi-planar rendering images for geometric distortion. Although the application of traveling wave in MRI does suffer from low excitation (small flip angles), there seems to be little to no correlation between traveling wave phase variability and frequency/phase encoding. Therefore, further experiments, if carried out, may enhance image quality such as RF shielding, the use of local receive coils, and/or the addition of a second patch antenna.

FP1.00076 Nanostructures: Temperature Dependence of Optical Properties for Solar Applications, ALVARO AGUILAR, SPS — Within solar cell technologies, thin-film cells have been proven to provide up to 20% efficiency in the laboratory. Our research group focused on Cadmium Telluride thin-film cells for two reasons: it can be readily synthesized as nano particles and it is known to make efficient thin-film cells. The optical characteristics of the CdTe layer of the cell were investigated with relation to temperature using the HORIBA Jobin Yvon Variable Angle Spectroscopic Ellipsometer and the LinkAM TMS94 Temperature Controller. Our results show that sintering nano particles of CdTe decreases the film’s thickness and shifts the Energy Gap toward lower energies. The method used can be applied to different nano structures and even new materials.
10:24AM SM1.00003 In-depth trapping and fluorescence excitation of microscopic objects using single optical fiber tweezers

10:36AM SM1.00004 Digital holographic microscopy and atomic force microscope integrated with optical microscope

10:48AM SM1.00005 Low-concentration chemical sensing using surface-enhanced coherent anti-Stokes Raman spectroscopy

11:00AM SM1.00006 Photon Transport Through Dense Atomic Vapor

11:12AM SM1.00007 Resonant dispersive waves generated with multi-input femtosecond pulses

11:24AM SM1.00008 A Newtonian Explanation of the Hydrogen Fine Structure
The orientation of Interplanetary Magnetic Field (IMF) plays an important role in Space weather prediction. The process in which Earth’s magnetic field interacts with IMF is called magnetic reconnection. The amount of reconnection determines the amount of energy transfer from the solar wind to Earth. For a given orientation of the IMF there exist effective length out in the solar wind, perpendicular to both the IMF and the Sun-Earth line, over which the solar wind flow is able to reach the reconnection region. This controls the rate at which the magnetic flux is merged and therefore the voltage imposed on the magnetosphere-ionosphere system. This length is called the geoeffective length. We present a method for determining geoeffective length from simulations of the solar wind magnetosphere interaction obtained from the Lyon-Fedder-Mobarry (LFM) code.

### Saturday, October 23, 2010 10:00AM - 12:12PM – Session SM2 Astrophysics, Astronomy, Space Science III University Center III Bexar Room, 1st floor - Eric Schlegel, University of Texas at San Antonio

**10:00AM SM2.00001 Determining geoeffective length from LFM simulation**

**L. MURPHY, S. BHATTARAI, R. LOPEZ, U. Arlington**

The orientation of Interplanetary Magnetic Field (IMF) plays an important role in Space weather prediction. The process in which Earth’s magnetic field interacts with IMF is called magnetic reconnection. The amount of reconnection determines the amount of energy transfer from the solar wind to Earth. For a given orientation of the IMF there exist effective length out in the solar wind, perpendicular to both the IMF and the Sun-Earth line, over which the solar wind flow is able to reach the reconnection region. This controls the rate at which the magnetic flux is merged and therefore the voltage imposed on the magnetosphere-ionosphere system. This length is called the geoeffective length. We present a method for determining geoeffective length from simulations of the solar wind magnetosphere interaction obtained from the Lyon-Fedder-Mobarry (LFM) code.

**10:12AM SM2.00002 TWINS Stereo Images of the Three-Dimensional Ring Current During Geomagnetic Storms in the Rising Phase of Solar Cycle 24**


During Geomagnetic Storms in the Rising Phase of Solar Cycle 24, the interplanetary magnetic field (IMF) orientation changes rapidly as the magnetic cloud swept through the magnetosphere. TWINS images can be used to determine the trajectory of the magnetopause, and the length of the solar wind that has reached the magnetosphere. These images can also be used to determine the relationship between the IMF and the geomagnetic field, and the time delay between IMF changes and the response of the Earth’s magnetic field.

**10:24AM SM2.00003 Applying Empirical Magnetopause Prediction to Results Obtained from MHD Simulations**

**K. PHAM, R. BRUNTZ, R. LOPEZ, U. Arlington**

One unresolved issue with the use of geomagnetic storms is the prediction of the location of the magnetopause. The location of the magnetopause is important in determining the amount of energy transfer from the solar wind to Earth. We present a method for determining the location of the magnetopause using empirical magnetopause prediction and MHD simulations. This method can be used to determine the location of the magnetopause in real-time, and can be used to predict the amount of energy transfer from the solar wind to Earth.

**10:36AM SM2.00004 Sawtooth Oscillations and Helicity of Magnetic Clouds**

**J. PETERSEN, U. Arlington undergraduate**

When an interplanetary magnetic field (IMF) running north-south encounters the Earth’s south-north magnetic field, magnetic reconnection occurs, and solar wind plasma is injected through the resulting gap in the magnetosphere. This process, known as geomagnetic storms, can have substorms with different characteristics. One such substorm is a sawtooth event or sawtooth oscillation. These quasi-periodic oscillations are caused by a specific type of IMF called a magnetic cloud. It is postulated herein that the helical structure of magnetic clouds as they are incident upon the magnetosphere is the root of the quasi-periodic. Furthermore, a simple calculation (H = 1/vt) can predict the helicity of the magnetic cloud, within the statistically accepted range, using the periodicity of the sawtooth oscillation and the velocity of the magnetic cloud for t and v, respectively.

**10:48AM SM2.00005 Time delay between IMF changes and the response of the nightside geosynchronous magnetic field**

**D. BREWER, R. BRUNTZ, R. LOPEZ, U. Arlington**

The interplanetary magnetic field (IMF) is the Sun’s magnetic field which is carried to the Earth via the solar wind. Some models predict that there will be a difference in how quickly Earth’s magnetic field responds to changes in the solar wind, depending on the strength of the IMF. In order to investigate the timing delay, we have found sudden, high-magnitude reversals in the north-south component of the IMF, using the OMNI database. We then observed the delay between the change in the IMF and the change in Earth’s magnetic field in the midnight sector using GOES satellites in geosynchronous orbit. We will report the magnitude of the delay between IMF changes and corresponding changes in the nightside magnetic field of the Earth, as well as the correlation between the delay and the magnitude of the IMF.
Variations in the Polar Cap Boundary Location Based on Solar Wind Parameters. Robert Allen, Sophia Cockrell, Bethany Hiller, Perla Gonzalez, Ramon E. Lopez, University of Texas at Arlington — The Earth’s magnetic field is a dipole with field lines coming out from the southern hemisphere and into the northern hemisphere. When the interplanetary magnetic field (IMF) is pointed southward, the Earth’s magnetic field becomes interconnected with the IMF. The boundary that separates the region of field lines that are connected to the Earth at both ends and the region of field lines that are connected to both the Earth and the IMF is called the polar cap boundary. We can detect the polar cap boundary using particle precipitation measurements from the Defense Meteorological Satellite Program (DMSP) satellite F13. The DMSP satellite F13 has approximately a 104-minute polar orbit that makes roughly dusk-dawn passes. We will investigate the variation of the polar cap boundary’s location based on solar wind parameters.

The nuclear symmetry energy dependence of the nuclear “pasta” phases in the inner crust of neutron stars. Michael Gearheart, Texas A&M University - Commerce — Neutron stars are the end point of the evolution of a star with between about 8 and 25 solar masses. The star’s core collapses to form an object with about 1.5 times the mass of our Sun and a radius of only 10 km. The average density of matter in a neutron star is comparable with that of the nuclei of atoms, making them interesting probes of nuclear physics in a regime inaccessible to terrestrial experiments. We present a study of the inner crust of neutron stars, a region of the star between 0.5 km and 1 km in depth where super-heavy neutron rich nuclei are arranged in a lattice co-exist with a gas of neutrons. Near the transition from the inner crust to the core of the star, the nuclei are expected to assume exotic shapes such as cylinders and slabs, referred to collectively as nuclear ‘pasta’. Using a compressible liquid drop model and a variety of different descriptions of the nucleon-nucleon interaction, we examine the composition and shape of nuclei at different depths in the inner crust up to the point where the nuclei dissolve into a uniform fluid of neutrons, protons and electrons. We examine the dependence of the densities at which nuclear shape transitions through various forms of the surface energy using experimentally measurable properties of nuclear matter such as the nuclear symmetry energy, comparing our results with that of measured nuclear masses.

Distribution of Carbon and Sulfur in the Crab Nebula. Andrea Katz, Gordon Macalpine, Trinity University — Chemical elements heavier than hydrogen and helium are made in stars, and investigations of the Crab Nebula supernova remnant provide excellent opportunities for understanding how stars make elements through nucleosynthesis processes. Carbon and sulfur are particularly important in this regard, because they are tracers of where helium and oxygen nuclear fusion have taken place. During the past year, we obtained and calibrated [CII] λλ 158723, 9850 and [SII] λλ 9069 emission-line images of the Crab Nebula, using appropriate filters at the 1.3-meter telescope of the Michigan-Dartmouth-MIT Observatory located on Kitt Peak in Arizona. Then we combined the emission-line flux distributions with a suite of more than 1000 numerical photoionization computations in order to map the actual carbon and sulfur abundances over the observed nebular structure. The results and implications for nuclear processing and distribution will be discussed.

Investigate the magnitude of gravitational wave due to quark-hyperon-transition during inside the neutron star. Wei Kang Lin, Bao-An Li, Texas A&M University-Commerce — In the next decade, it is hoped to be able to detect gravitational waves. The detection of gravitational wave provides us a new way to investigate our universe or even the microscopic world, the nuclear matter for example. There is strong relation between the gravitational waves and the state of matter inside the neutron stars. Extreme environment might appear inside the neutron stars. Hyperons or even a transition from hadrons to quark matter might be presented. A hyperons-Quark transition might be a low mass neutron star accreting mass from its companion in an X-ray binary, or by spinning down and increasing the density at its central. We investigated the maximum energy available for stochastic gravitational waves generated by neutron stars through oscillations coupling with rotations during a phase transition from hadron matter to deconfined quark-gluon matter in the core of them. The energy difference, between the configurations with and without a quark-gluon matter core, is used to estimate the maximum available energy. The properties of neutron stars were computed using isospin- and momentum-dependent MDI interaction and MIT model. Our results indicate the available energy is not large enough to reach the present detectable interest. However, the results show that the available energy depends on the different bag constants and symmetry energies.

The Segmented Universe: Identifying Cosmic Voids with a Multi-scale Geometric Flow. Andrew Miller, Department of Physics, University of Dallas, Irving, TX 75062, Ali Snedden, Lara Arielle Phillips, Department of Physics, University of Notre Dame, Notre Dame, IN 46556 — The complex, filamentary nature of large-scale dark matter and density structure in the universe has been detected by redshift surveys and modeled by large N-body simulations of cosmic evolution. We present a multi-scale geometric flow algorithm as a quantitative method for the analysis of such structure. The algorithm, adapted from medical imaging identification of brain vasculature, segments a volumetric density field according measures of local structure derived from local curvature, identifying vessel-like, sheet-like, and clump-like formations. We apply this structure segmentation to a cold dark matter (CDM) density field prepared from the Virgo Consortium’s 2005 Millennium Simulation (MS) output, focusing on identification of regions of cosmic void to determine the robustness of this segmentation method through a systematic comparison of its results with those of previously published void-finding algorithms. The initial results of our application of this segmentation algorithm and the data pipeline used will be presented.

Mapping Class I Methanol Masers in the DR21 Region. Talitha Muehlbrad, Texas Lutheran University, V. Fish, P. Pratap, MIT Haystack Observatory, L.O. Sjouwerman, Nrao, V. Strelntski, Maria Mitchel Observatory, Y.M. Pihsstrom, University of New Mexico, T.L. Bourke, Harvar-Smithsonian Center for Astrophysics — Class I methanol masers are believed to be produced in the shock-excited environment around star-forming regions and are believed to be indicative of stages of star formation or excitation conditions. We report on the first EVLA observations of the 36-GHz methanol masers as well as on Submillimeter Array observations of the 229-GHz methanol masers in DR21OH, DR21N, and DR21W. The data are compared to existing Class I methanol data in other transitions in each region. In the outflow of DR21OH, the distribution of the 36-GHz masers is similar to that of the other transitions. At the main continuum source in this region, the 36- and 229-GHz masers virtually overlap with the Class II 6.7-GHz masers.

11:48AM SM2.00010 The Segmented Universe: Identifying Cosmic Voids with a Multi-scale Geometric Flow. Andrew Miller, Department of Physics, University of Dallas, Irving, TX 75062, Ali Snedden, Lara Arielle Phillips, Department of Physics, University of Notre Dame, Notre Dame, IN 46556 — The complex, filamentary nature of large-scale dark matter and density structure in the universe has been detected by redshift surveys and modeled by large N-body simulations of cosmic evolution. We present a multi-scale geometric flow algorithm as a quantitative method for the analysis of such structure. The algorithm, adapted from medical imaging identification of brain vasculature, segments a volumetric density field according measures of local structure derived from local curvature, identifying vessel-like, sheet-like, and clump-like formations. We apply this structure segmentation to a cold dark matter (CDM) density field prepared from the Virgo Consortium’s 2005 Millennium Simulation (MS) output, focusing on identification of regions of cosmic void to determine the robustness of this segmentation method through a systematic comparison of its results with those of previously published void-finding algorithms. The initial results of our application of this segmentation algorithm and the data pipeline used will be presented.

12:00PM SM2.00011 Mapping Class I Methanol Masers in the DR21 Region. Talitha Muehlbrad, Texas Lutheran University, V. Fish, P. Pratap, MIT Haystack Observatory, L.O. Sjouwerman, Nrao, V. Strelntski, Maria Mitchel Observatory, Y.M. Pihsstrom, University of New Mexico, T.L. Bourke, Harvar-Smithsonian Center for Astrophysics — Class I methanol masers are believed to be produced in the shock-excited environment around star-forming regions and are believed to be indicative of stages of star formation or excitation conditions. We report on the first EVLA observations of the 36-GHz methanol masers as well as on Submillimeter Array observations of the 229-GHz methanol masers in DR21OH, DR21N, and DR21W. The data are compared to existing Class I methanol data in other transitions in each region. In the outflow of DR21OH, the distribution of the 36-GHz masers is similar to that of the other transitions. At the main continuum source in this region, the 36- and 229-GHz masers virtually overlap with the Class II 6.7-GHz masers.

To the south of the region, 36-GHz masers are scattered with 44-GHz masers, but the two transitions do not appear coincident. A magnetic field of 58.1±6.2 mG is detected in DR21W. If this magnetic field is related to the density with usual scaling, the resultant high density may be indicative of an alternative pumping scheme than that commonly assumed for Class I masers.

This research was funded in part by the National Science Foundation REU program.
10:00AM SM3.00001 Application of Carbon Nanotubes as Working Electrodes for Cyclic Voltammetry & Impedance Spectroscopy1, JOSEPH BARRIOS, UTSA MEMS Lab, MURILO CABRAL, EMÂNUEL CARRILHO, USP, Institute of Chemistry at Sao Carlos, CARLOS GARCIA, UTSA, Dept. of Chemistry, ARTURO AYON, UTSA, MEMS Lab — Research conducted focuses on applications of Multi Walled Carbon Nanotubes (MWCNTs) serving as working electrodes for cyclic voltammetry (CV) and impedance spectroscopy. Expectations of increased electrochemical properties of the working electrodes were confirmed and the analysis of CNTs electrical properties was obtained. Conditions for the MWCNTs are as follows: after acidic functionalization, MWCNTs bonded with N-hydroxysuccinimide, and MWCNTs bonded with the AChE protein. Iron cyanide was chosen as the optimal analyte solution. Concentration of MWCNTs on the working electrode was also investigated. With CV an increase in capacitance, sensitivity, and sensibility was noticed. When compared to the unmodified graphite carbon electrode the modified electrode yielded lower resistivity, and higher capacitance. When compared to NHS and the AChE protein, the functionalized CNTs yielded a higher capacitance, increased sensitivity and sensibility with decrease in surface roughness. Through FTIR analysis the presence of increased carboxyl groups, enzymes, and N-hydroxysuccinimide on the walls of the MWCNTs was confirmed. In conclusion the addition of MWCNTs improved the electrodes sensitivity and sensibility for CV.

1This research was funded by an NSF grant for the study abroad program.

10:12AM SM3.00002 Insights into the Structure of MoS

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depcsructs revealed various interesting aspects for the first time to our knowledge. microscopy (STEM) along with simulated STEM images has been carried out to understand better the structure of the nanotubes. Further details involving the nature of the nanotubes, as well as the structural bonding of the Mo-S in the nanotubes have been investigated, and our results have revealed various interesting aspects for the first time to our knowledge.

10:24AM SM3.00003 Voltage induced by domain wall motion in a ferromagnetic nanowire , YANG LIU, OLEG TRETIAKOV, ARTEM ABANOV, Department of Physics, Texas A&M University — We study current-induced domain-wall motion in a narrow ferromagnetic wire. We obtain an analytic expression for the voltage variation caused by the domain wall motion. Our finding shows that above critical current, the voltage will be periodic as the tilt angle of domain wall. Furthermore, we propose several possible measurements of the voltage to determine the parameters, which describe the motion of domain wall.

10:36AM SM3.00004 Evolution of Structure and Energy Stability of Ag Nanoparticles1, HECTOR BARRON, JUAN PEDRO PALOMARES-BAEZ, Instituto Potosino de Investigacion Cientifica y Tecnologica, JESUS VELAZQUEZ-SALAZAR, University of Texas at San Antonio, JOSE LUIS RODRIGUEZ-LOPEZ, Instituto Potosino de Investigacion Cientifica y Tecnologica, MIGUEL JOSE-YACAMAN, University of Texas at San Antonio, UNIVERSITY OF TEXAS AT SAN ANTONIO COLLABORATION, INSTITUTO POTOSINO DE INVESTIGACION CIENTIFICA Y TECNOLOGICA COLLABORATION — Nanotechnology is a leading interdisciplinary science that is emerging as a distinctive field of research. Its advances and applications will result in technical capabilities that will allow the development of novel nanomaterials with applications that will revolutionize the industry in many areas. In this work we present the structural evolution and energy stability results for silver nanoparticles from the small (1-2 nm) to the big (50 nm) size ranges. We have found that the appearances of structural lattice defects are important factors that influence the growth process. A simple assembly model for a path transformation for silver nanoparticles is presented and compared with experimental evidence.

1Acknowledgements: Financial support from National Science Foundation Grant DMR-0934218.

10:48AM SM3.00005 The Dyakonov-Perel spin dynamics in the strong spin-orbit coupling regime , XIN LIU, XIONG-JUN LIU, JAIRO SINOVA, Department of Physics, Texas A&M University, College, JAIRO SINOVA’S GROUP SPINTRONICS AND NANOELECTRONICS RESEARCH TEAM — We study the spin evolution in a high-mobility two-dimensional electron gas (2DEG) with generic spin-orbit interactions (SOI). A fully understanding of the D’yakonov-Perel’s (DP) mechanism is presented by using the microscopic linear response theory from the diffusive to the ballistic regime. We derive a set of spin dynamical equations which capture the characters of the purely exponential and damped oscillatory spin evolution modes in the different spin-orbit coupling (SOC) regime. It is shown that the oscillatory spin dynamics appear when the electron life time is larger than the half of the spin precession time due to the SOI. We also proposed a way to measure the SOC strength and the electron life time from the spin oscillatory mode.

11:00AM SM3.00006 Internal and External Radiative Decay Engineering of Rare Earth Doped Nanocrystalline Sesquioxides1, ROBERT DENNIS, The University of Texas at San Antonio, KELLY NASH, MAOGEN ZHANG, WALDEMAR GORSKI, DHRAIJ SARDAR, The University of Texas at San Antonio — Rare earth (RE) based sesquioxide structures (REO3), when doped judiciously with trivalent RE ions, are not susceptible to photocleaching and offer many sharp electronic transitions with excited state lifetimes on the order of milliseconds. Additionally, internal lattice engineering of the host offers several distinct crystal phases which may be synthesized easily by tuning the host RE. Similarly, the proximity of noble metals to trivalent rare earth ions has shown promise as a sensitizer that greatly enhances the photoluminescence of the rare earth ion. More recently, results have been reported for gold coated silica dielectric nanoparticles which have been modeled extensively and shown to act as a nano-antenna, enhancing the electric field inside the dielectric core. This short range antenna effect offers radiative decay engineering at the external level. Here, we report the internal and external radiative decay engineering of several rare earth doped sesquioxide and metallic hetero-nanostructures and discuss the nanoscale physics of these systems.

1This research was support by the National Science Foundation PREM grant No. DMR-0934218.
11:12AM SM3.00007 Synthesis and Modification of Selected Rare Earth Nanoparticles. DIVYA GUTHIKONDA, Department of Chemistry, UTSA, ROBERT DENNIS, Department of Physics and Astronomy, UTSA, MAOGEN ZHANG, Department of Chemistry, UTSA, KELLY NASH, Department of Physics and Astronomy, UTSA, WALDEMAR GORSKI, Department of Chemistry, UTSA — The goal of this research is to develop multifunctional nanomaterials for biological applications. The rare earth based nanoparticles (RENPs) have a potential to offer multiple functionalities, which can be utilized in more comprehensive imaging of biological tissues. The specific goal was to modify the RENPs with clusters of transition metals in order to enhance their luminescence signal. The luminescent system based on the Er\(^{3+}\)/Y\(_2\)O\(_3\) nanoparticles (NPs) was selected for the present studies. Several synthetic approaches were investigated in order to control the size and shape. The precipitation from homogenous solution using the urea decomposition yielded perfectly spherical Er\(^{3+}\)/Y\(_2\)O\(_3\) with narrow size distribution and particle diameter of approximately 250 nm. The synthesis of Er\(^{3+}\)/Y\(_2\)O\(_3\) using the microemulsion precipitation resulted in the irregularly shaped NPs with the average diameter of approximately 100 nm. The Er\(^{3+}\)/Y\(_2\)O\(_3\) NPs surrounded by chitosan shell were modified with gold clusters in order to enhance their luminescence by metallic surface plasmon resonance. The luminescence of such [Er\(^{3+}\)/Y\(_2\)O\(_3\)][Chitosan-Au] hybrid NPs was investigated as a function of the gold content in the chitosan shell.

11:24AM SM3.00008 The Growth and Characterization of PbTe/CdTe at Texas State University. KEVIN DOYLE, KYOUNG-KEUN LEE, AMANDA GREGORY, GOKUL RADHAKRISHNAN, RAVI DROOPAD, THOMAS MYERS, Texas State University-San Marcos — The new Materials Science, Engineering, and Commercialization program at Texas State University (MSEC) has developed a state-of-the-art nine-chamber molecular-beam epitaxy (MBE) growth chamber for semiconductor growth, consisting of II-VI, III-V, and IV-VI compounds. We present the results of heteroepitaxial PbTe/CdTe growth doped with Ti that was characterized through a variety of techniques, including variable-field Hall measurement and quantitative mobility spectrum analysis. We report on the need for consideration of the anisotropy of the conduction and valence bands during analysis. By producing these structures, MSEC can work to improve devices such as photodiodes and thermo-electrics for a wide variety of applications.

11:36AM SM3.00009 Structure of MoS\(_2\) Plates as Revealed by High Resolution Electron Microscopic Techniques. CARLOS CASTRO GUERRERO, LEONARD DEEPAK, MIGUEL JOSE-YACAMAN, University of Texas at San Antonio — Molybdenum disulfide (MoS\(_2\)) is a compound found in nature as molybdenite, natural MoS\(_2\) has a hexagonal crystal form. MoS\(_2\) is a compound very useful for its properties; it is used as lubricant, catalyst in hydrosulfurization, in hydrogen fuel storage, etc. Currently, researchers are synthesizing MoS\(_2\) with new shapes and MoS\(_2\) nanoparticles. In this work MoS\(_2\) nanohexagonal plates were synthesized at different temperatures and characterized with XRD, SEM, Raman spectroscopy and HRTEM. This compound has a plate size of 20–30 nm as revealed by SEM, with HRTEM was possible to measure the interatomic distance of Mo–Mo, which was 2.8 Å. This analysis. We report on the need for consideration of the anisotropy of the conduction and valence bands during analysis. By producing these structures, MSEC can work to improve devices such as photodiodes and thermo-electrics for a wide variety of applications.

11:48AM SM3.00010 Crystallization of Germanium for Use in Low-Cost Solar Cells. CHRISTEN RACCIATO, University of Dallas. PHIL AHRENKIEL, South Dakota School of Mines and Technology — Solar cells with a Germanium substrate can reach 40% efficiency on earth with the aid of solar concentrators; however, Ge is expensive, meaning that these high-efficiency cells are feasible only for extreme applications such as outer-orbit missions. The purpose of this research is to determine if annealing Ge thin films may be a possible, low-cost alternative to slicing large, thick wafers of Ge for solar cells. Samples of Ge were deposited on transmission electron microscope (TEM) grids through vacuum evaporation, annealed at various temperatures and lengths of time in a tube furnace, and then analyzed through the TEM to test the annealed thin films. This tests the ease of crystallization in Ge, and if the size of the grains is reasonable. It was found that the Ge crystalized at relatively cost-effective temperatures, specifically temperatures over 400 C with moderate grain sizes reaching 7 μm. Experiments to evaluate whether grains of the size obtained can support a photovoltaic layer will be conducted in later research.

1This research was funded by the National Science Foundation (Grant #: 0852057)

2Department of Physics

3Department of Nanoscience and Nanoengineering

12:00PM SM3.00011 Synthesis, Morphology, and Optical Characterization of Nanocrystalline Er\(^{3+}\)/Y\(_2\)O\(_3\). SREERENJINI CHANDRA, FRANCIS LEONARD DEEPAK, JOHN B. GRUBER, DHIRAJ K. SARDAR, UTSA — We describe a methodology to synthesize trivalent erbium doped yttrium oxide (Er\(^{3+}\)/Y\(_2\)O\(_3\)) nanoparticles having an average diameter of about 25 nm. The room-temperature absorption spectrum obtained between 400 and 900 nm wavelength range and the fluorescence spectra of the Er\(^{3+}\)(4\(f\))\(^{11}\) \(^2\)H(2)\(_{11/2}\)\(^2\)S\(_{5/2}\) → \(^4\)I\(_{15/2}\) and \(^4\)F\(_{9/2}\) → \(^4\)I\(_{15/2}\) transitions were analyzed in detail. The lifetimes for the \(^2\)H(2)\(_{11/2}\)\(^2\)S\(_{5/2}\) and \(^4\)F\(_{9/2}\)\(^4\)I\(_{15/2}\) metastable states have been measured and investigated the effect of Er\(^{3+}\) concentrations and particle size on the emission intensity and decay times. The detailed structural and optical analyses suggest that the nanoparticles of Er\(^{3+}\)/Y\(_2\)O\(_3\) have potential applications in diverse fields of photonics including laser systems and optical communication devices.

1This research was supported by the National Science Foundation Grant No. DMR-0934218.

Saturday, October 23, 2010 10:00AM - 11:48AM – Session SM4 Computational and General II University Center I Pecan Room, 2nd floor - Liao Chen, University of Texas at San Antonio
10:00AM SM4.00001 Simulating rigid body motion in incompressible two phase flow for applications in energy harvesting\(^1\), CURTIS LEE, Texas Lutheran University, JESSICA SANDERS, JOHN DOLBOW, Duke University, PETER MUCHA, UNC, TOD LAURSEN, Duke University — Computational treatment of floating solids, in the presence of free surfaces and/or breaking waves, poses several modeling challenges. A motivating example where these systems are of interest is found in offshore wave energy harvesting systems, where a floating structure converts mechanical oscillations to electrical energy. In this work, we take the first steps in developing a robust computational strategy for treating rigid bodies with possible internal dynamics, such that they may be fully coupled to a fluid environment with free surfaces and arbitrarily large fluid motion. Our technique solves Lagrangian type rigid body equations coupled with the Eulerian formulation of the Navier Stokes equations for an immersed solid. This technique represents a subtle departure from standard methods, which solve the equations of motion completely on the Eulerian grid, and therefore facilitates the integration of internal components. To demonstrate this ability, simple rotational and translational components have been implemented with promising results. 

\(^1\)This research was supported by the National Science Foundation.

10:12AM SM4.00002 Numerical Simulation of Optical Propagation through Atmospheric Turbulence\(^1\), PUSHPA RAJ PUDASAINI, UT at San Antonio, MICHAEL VERA, University of Southern Miss, MADHAB POKHERAL, UT at San Antonio — We studied the propagation of optical waves through atmospheric turbulence. The extended random media is modeled by a set of two dimensional thin Gaussian phase screens with the phase power spectral densities appropriate to the natural medium being modeled. We use the spectral developed by Kolmogorov for the variation of index of refraction. Rather than treat these perturbations throughout the atmosphere, their effect for a portion of the propagation is usually addressed using a phase screen. This modeling method alters the phase of the optical wave at a discrete series of locations, in a way that corresponds to the cumulative impact of the fluctuations. Usually in the interest of the computational efficiency, simulation of the optical travel proceeds by using a position space representation of the wave function at the screen location, then using the Fourier methods to propagate between screens in the wave vector space representation. We used Crank-Nicolson method for simulating the propagation between the screens. We studied the inner scale effect on the irradiance variance for the different strength parameters. Our simulation results bear the strong resemblance to laser propagation experiment over kilometer length path in the atmosphere.

10:24AM SM4.00003 Accelerating Convergence of Generalized Hypergeometric Functions\(^1\), JOSHUA WILLIS, Abilene Christian University — The class of generalized hypergeometric functions \( p F_q \) is very broad, encompassing many of the special functions of physics. They can be defined by a power series that, for \( q+1 F_q \), converges when \( |z| < 1 \). But in many cases of interest, particularly at the branch point \( z = 1 \), this power series converges too slowly to be computationally useful. Series acceleration techniques can often transform a slowly convergent series into a computationally feasible algorithm, but for complex parameters the generalized hypergeometric function resists most acceleration techniques. In this talk we show how we can accelerate such series, using remainder estimates in terms of inverse power series that can be calculated to any desired asymptotic order. For many cases, this may provide an effective technique to evaluate such functions, particularly near the branch point where direct integration of the differential equation fails.

\(^1\)Supported in part by ACU Math/Science Research Fund.

10:36AM SM4.00004 Further Studies of Hydrogenic Quantum Systems Using the Feynman-Kac Path Integral Method\(^1\), J.M. REJCZEK, N.G. FAZLEE, Department of Physics, University of Texas at Arlington — The Feynman-Kac path integral method is applied to atomic hydrogen quantum system for the purpose of evaluating eigenvalues. These are computed by random walk simulations on a discrete grid. The study includes rescaling and the use of symmetry that allows higher order eigenstates to be computed. The method provides exact values in the limit of infinitesimal step size and infinite time for the lowest eigenstates.

10:48AM SM4.00005 Computational Study of a Random Surface Model, MATTHEW DRAKE, JONATHAN MACHITA, University of Massachusetts, YOUJIN DENG, USTC, DOUGLAS ABRAHAM, Rudolph Peiers Centre for Theoretical Physics, Oxford, UK, CHARLES NEWMAN, Courant Institute, NYU — We present results of Monte Carlo simulations of the equilibrium random surface model proposed in [1]. The model includes both the Volmer-Weber and Stranski-Krastanow growth regimes. In one limit, the model reduces to the two-dimensional Ising model in the height representation. We find that the critical temperature is reduced when the Ising model is constrained of a single height steps is relaxed. The critical properties of the model are explored using a variant of the worm algorithm.


11:00AM SM4.00006 New Trigger Logic for the STAR Forward Meson Spectrometer\(^1\), JOHN CALVIN MARTINEZ, Texas A&M University Kingsville — The Forward Meson Spectrometer (FMS) is an electromagnetic calorimeter in the STAR Experiment at RHIC that covers the pseudorapidity region 2.5 < \( \eta \) < 4 and full azimuth. One of the goals of the FMS is to separate two possible causes of large, previously observed proton transverse single-spin asymmetries, the Sivers effect and the Collins effect. To separate two possible causes of large, previously observed proton transverse single-spin asymmetries, the Sivers effect and the Collins effect. To meet this goal, it will be valuable for the FMS to trigger more efficiently on \( \eta \) mesons and jet-like events than it does at present. In order to increase the trigger efficiency for non-localized events, like jets and \( \eta \) decays, a new trigger algorithm has been developed that includes a system of eight overlapping jet-patches, each covering an approximate area of 1.5 x 1.5 in azimuth-pseudorapidity space. This technique represents a subtle departure from standard methods, which solve the equations of motion completely on the Eulerian grid, and therefore facilitates the integration of internal components. To demonstrate this ability, simple rotational and translational components have been implemented with promising results. 

\(^1\)The Cyclotron Institute 2010 REU, Texas A&M University. The NSF and THE STAR Collaboration.

11:12AM SM4.00007 A Newtonian Description of the Linear Stark Effect, JAMES WOODYARD, West Texas A&M University, JAMES ESPINOSA\(^1\), Rhodes College — After the discovery of the magnetic effect on spectral lines by Zeeman, it was only natural that physicists should look for a similar effect when an electric field was applied. A nonlinear model of the hydrogen atom developed by Woldemar Voigt was investigated and predicted a second order effect that would require huge electric fields in the ten of millions of volts per centimeter. Fortunately, Johannes Stark ignored this ominous prediction by a leading theoretician and discovered a linear electric effect that would quickly be named after himself. Soon after Bohr introduced his quantum theory of the Hydrogen Atom, Schwarzschild and Epstein independently utilized Sommerfeld’s extension of Bohr’s theory to arrive at an empirically correct formula. We will show how our classical theory of the hydrogen atom can account for the linear Stark effect.

\(^1\)Present employer TGS-NOPEC
11:24AM SM4.00008 Wide-Angle Spectral Split-Step Method for 2D or 3D Beam Propagation, CLIFTON CLARK, UTSA, ROBERT THOMAS, USAF, RHDO TEAM — We develop a method for non-paraxial beam propagation that obtains a speed improvement over the Finite-Difference Split-Step method (FDSSNP) recently reported by Sharma et al. The method works in the eigen-basis of the Laplace operator ($\nabla^2$), and in general requires half as many operations to propagate one step forward so that a 2X speedup can be realized. However, the new formulation allows the Fast Fourier Transform (FFT) algorithm to be used, which allows an even greater speedup. The method does not require a numerical matrix inversion, diagonalization, or series evaluation. The diffraction operator is not approximated, and in the absence of refractive index fluctuations the method reduces to an exact solution of the Helmholtz equation.

11:36AM SM4.00009 Compact Accelerator Driven Thorium Cycle Subcritical Reactor, AKHDIOY S SATTAROV, PETER MCINTYRE, Texas A&M University — Thorium cycle subcritical reactor driven by 800MeV protons delivered by flux coupled superconducting stack of cyclotrons can operate as a sealed unit for up to 7 years and is stable against melt-down. Small, low power units with minimum security and small crew of operators are perfect candidates for powering remote small towns. The reactor can eat long-lived waste coming from conventional nuclear power plants and can be used as sealed waste processing unit powering at the same time remote, low power demanding objects.

Saturday, October 23, 2010 10:00AM - 12:24PM — Session SM5 Condensed Matter University Center III Ballroom I, 1st floor - Wilhelmus Geerts, Texas State University

10:00AM SM5.00001 Estimation of the background due to inelastically scattered photoemitted valence band electrons in Ag (100) using APECS, S. KALASKAR, Univ of Texas Arlington, S.L. HULBERT, Brookhaven National Lab, B.R. BARTVINSKI, Rutgers University, A.H. WEISS, Univ of Texas Arlington — Auger Photoelectron Coincidence Spectroscopy (APECS) was used to investigate the Low Energy tail (LET) region of the Auger spectrum of Ag(100) sample. The measurements were carried out at the National Synchrotron Light Source, Brookhaven National Lab, and the spectrum shows a NVV transition related to Ag 4p excitation consisting of a Auger peak accompanied by a substantial low energy region. The fixed energy analyzer was set to the Ag 4p core peak and the APECS LET contains the decay features of only that core excitation process. The spectra contains background due to true coincidences between photoemitted valence band electrons that undergo inelastic scattering and transfer part of their energy with other valence electrons which exit the sample. A series of measurements made with the fixed analyzer set at energies 150,160,171 and 175eV above the energy of the core level peak were obtained and estimate this background. The spectrum that results from the subtraction of the estimated background contains significant intensity in the LET region indicating the emission related to Ag 4p core excitation.

10:12AM SM5.00002 Magneto-Plastic Properties of Ion Beam Sputtered Thin Films on Nitinol Sheet Metal, AMANDA GREGORY, WILHELMUS J. GEERTS, ANUP BANDYOPADHYAY, Texas State University-San Marcos — Thin magnetic films are used in a variety of applications, and over the course of their lifetimes will likely undergo some degree of plastic deformation. In order to study the ways in which this deformation affects the magnetic properties of thin films, we have deposited films of different thicknesses and compositions on a super-elastic Nitinol substrate and submitted them to varying percentages of strain. The samples were strained using an Instron 5566 materials tester, and a special sample holder was developed to measure the magnetic hysteresis by Vibrating Sample Magnetometer (VSM) in between straining cycles. Our experiments reveal that there is a small process window for which ion beam sputtered thin films do not detach from Nitinol substrates that have undergone up to 5% strain. The sample holder and the magneto-plastic properties of the robust magnetic thin film coatings will be discussed. Additionally, a short video of the straining experiments will be shown.

10:24AM SM5.00003 Positron Annihilation Spectroscopy of High Performance Polymer Films under CO$_2$ Pressure, C.A. QUARLES, Texas Christian University, JOHN R. KLAEHN, ERIC S. PETERSON, Idaho National Laboratory, JAGODA M. URBAN-KLAEHN, Pajariito Scientific Corporation — Positron annihilation lifetime and Doppler broadening measurements are reported for six polymer films as a function of carbon dioxide (CO$_2$) absolute pressure ranging from 0 to 45 psi. Since the polymer films were thin and did not absorb all positrons, corrections were made in the lifetime analysis for the absorption of positrons in the positron source and sample holder using the Monte Carlo transport code MCNP. Some polymers studied form positronium and others, such as the polyimide structures, do not. For those polymers that form positronium an interpretation in terms of free volume is possible; for those that don’t form positronium, further work is needed to determine how best to describe the behavior in terms of the bulk positron annihilation parameters. A few of the studied polymers exhibit changes in positron lifetime and intensity under CO$_2$ pressure which may be described by the Henry or Langmuir sorption models, while the positron response of other polymers is rather insensitive to the CO$_2$ pressure. The results demonstrate the usefulness of positron annihilation spectroscopy in investigating the sorption of CO$_2$ into various polymers.

10:36AM SM5.00004 Dependence of calixarene electron beam sensitivity and contrast on functionalization, GREGORY SPENCER, DANIEL RALLS, ANUP BANDYOPADHYAY, MICHAEL BLANDA, Texas State University — Calixarenes form a group of compounds that have been studied as high resolution, high contrast electron beam resists by many groups. They have been shown to be capable of high resolution. While the ultimate resolution may be limited by the size of the calix molecule (~ 1 nm), both sensitivity and contrast also contribute to their performance. In this study, a particular calixarene molecule has been tested for sensitivity and contrast with differing numbers of attached functional groups. The specific calixarene contained 6 benzene rings and was locked conformationally using bridging xylényl groups to produce two conformations: a cone conformer and a 1,2,3-alternate conformer. To these calix[6]arenes various numbers of allyl groups were added to improve their electron beam sensitivity. The number of these added groups ranged from 0 to 8 groups. The resulting resists (1% solution with chlorobenzene) were subjected to electron beam exposure. Contrast curves for the cone and alternate conformers were measured by AFM. From this data, both sensitivity and contrast of the resists were found as a function of the number of attached groups. These results and comparison with others will be discussed.

1Supported in part by NSF grant MRI 0414202 and IGERT 0549487.
10:48AM SM5.00005 Background suppressed measurements of the Low Energy CVV Auger transitions in Cu and Ag(100)¹. K. SHAstry, UTA, S. MUKHERJEE MUKHERJEE, NCSU, S. KALASKAR, UTA, S.L. HULBERT, BNL, B.R. BARTYNSKI, Rutgers Univ, A.H. WEISS, UTA — Low energy Auger lineshapes are difficult to measure because they sit on a large background due to secondary electrons arising from loss processes unrelated to the Auger mechanism. Auger photoelectron coincidence spectroscopy (APECS) was used to the spectrum of the MVV and NVV Auger peaks and associated low energy tails (LETs) in Cu and Ag (100) respectively. The backgrounds due to secondary electrons unrelated to the auger process were suppressed by measuring the Auger spectra in coincidence with the M and N core levels. The APECS measurements reveal a well formed Auger peak at 40 and 60 eV for Cu and Ag respectively accompanied by a significant Auger related intensity in the low energy region. Spectra obtained using APECS are compared with Positron Annihilation Induced Auger Electron Spectroscopy (PAES) measurements which also show a large LET. The LET is discussed in terms of extrinsic mechanisms in which the electrons from the peak lose energy as they propagate to the sample surface and intrinsic mechanisms in which multi- electron auger processes distribute the energy gained by filling of the core hole to multiple electrons.

¹Welch Y1100 NSF DMR 0907679

11:00AM SM5.00006 Surface Reconstruction of TiO₂(001) Studied by STM and LEED. N.-H. YU, K.T. PARK, Department of Physics, Baylor University, Waco, TX 76798, USA. A. ZHANG, E.W. PLUMMER, Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803, USA, DEPARTMENT OF PHYSICS, BAYLOR UNIVERSITY, WACO, TX 76798, USA TEAM, DEPARTMENT OF PHYSICS AND ASTRONOMY, LOUISIANA STATE UNIVERSITY, BATON ROUGE, LA 70803, USA TEAM — TiO₂(001) has been investigated by scanning tunneling microscopy (STM) and low energy electron diffraction (LEED). After cycles of Ar sputtering and surface annealing at moderate temperatures (up to 600 °C for 15 minutes), TiO₂(001) reveals the so-called latticework reconstruction: row-like linear structures running along [110] and [1-10] directions. Each row further consists of bright spots separated by 6.5 Å, the lattice constant of the rutile along [110] and [1-10]. In some areas, the rows are separated by 6.5 Å and with the increasing step height of 3 Å, thus forming {111} microfacets. In other areas, the rows are distributed in a more random fashion. Together with LEED, the STM data suggest that the surface reconstruction can be described by added rows of stoichiometric TiO₂. Further details of the reconstruction model will be presented.

11:12AM SM5.00007 Theoretical aspects of study of high coverage oxidation of the Cu(100) surface using low energy positrons. N.G. FAZLEEV, W.B. MADDUX, Department of Physics, University of Texas at Arlington — The study of adsorption of oxygen on transition metal surface is important for the understanding of oxidation, heterogeneous catalysis, and metal corrosion. The structures formed on transition metal surfaces vary from simple adlayers of chemisorbed oxygen to oxygen diffusion into the sub-surface region and the formation of oxides. In this work we present the results of an ab-initio investigation of positron surface and bulk states and annihilation probabilities of surface-trapped positrons with relevant core electrons at the oxidized Cu(100) surface under conditions of high oxygen coverage. Calculations are performed for various high coverage missing row structures ranging between 0.50 and 1.50 ML oxygen coverage. Calculations are also performed for the on-surface adsorption of oxygen on the unreconstructed Cu(001) surface for coverages up to one monolayer to use for comparison. The geometry of the surfaces with adsorbed oxygen is fully optimized. Theoretical results are compared with experimental data obtained from studies of oxidation of the Cu(100) surface using positron annihilation induced Auger electron spectroscopy.

11:24AM SM5.00008 Residual stress in zinc oxide thin films deposited by atomic layer deposition. DAVID ELAM, RAMAKRISHNA KOTHIA, ARTURO AYON, ANDREY CHABANOV, University of Texas San Antonio — The residual stress in a thin film can have an impact on the electrical and optical properties of the film. In addition, stress is an important consideration when incorporating the material into a microelectromechanical (MEMS) device as large unexpected stresses can cause such a device to fail. The residual stress in ZnO thin films prepared by atomic layer deposition was measured using a radius of curvature technique. The results show relatively low residual stresses on the order of ~0.1 GPa. The stress is observed to change from tensile to compressive as a function of increasing deposition temperature. The polycrystalline structures of the films are also investigated using XRD techniques.

11:36AM SM5.00009 The Design and Fabrication of Bismuth Hall Effect Biosensors. ANTHONY SIGILLITO, Department of Physics, University of Dallas 75062, MARTIN RUDOLPH, VICKI SOGHOMONIAN, J.J. HEREMANS, Department of Physics, Virginia Tech 24060 — Because of their high sensitivity, accuracy, and low cost, the use of Hall sensors promises to be an effective diagnostic technique that may aid in the early diagnosis of diseases. In this research, Hall sensors were fabricated from thermally evaporated bismuth thin films. The bismuth films were deposited under high vacuum onto heated Si/SiO₂ substrates using a two layer deposition technique. The films varied in thickness from 60 nm to 75 mm and were etched into Hall bar geometries using photolithography and wet chemical etching. Magnetoresistance and Hall measurements were taken from 4 K to 300 K. The data indicate that the sensors may be characterized using a two carrier model with high mobility, low density holes and low mobility, high density electrons. Additionally, the sensors were exposed to magnetite nanoparticles and characterized using atomic force microscopy. The results will be reported. This research was funded by the National Science Foundation (NSF Grant DMR-0851662).

11:48AM SM5.00010 Using Spectroscopic Ellipsometry to Distinguish Between Si and SiO₂ Nanoparticles. JUSTIN FRASIER, GREGORY SPENCER, ANUP BANDYOPADHYAY, WILHELMUS GEERTS, Texas State University-San Marcos — Silicon-based nanoparticles have been synthesized by annealing a thin layer of Si (~ 10 nm) that was deposited upon thermally-oxidized silicon wafers. Samples were annealed at various temperatures (600 to 900 °C) in UHV and by RTA in flowing Ar to study the particle size distribution dependence on process parameters. Typical particle sizes measured by AFM ranged from 100 to 250 Å. Particle densities up to 50% were observed. Nondestructive spectroscopic ellipsometry was utilized through effective medium approximations (EMA) to determine whether or not the resulting nanoparticles were pure Si, a Si core with oxide shell, or fully oxidized. EMA analysis is based upon the models proposed in the Lorentz-Lorenz (LL), Maxwell-Garnett (MG), and Bruggeman methods. These allow the estimation of the optical constants (N₁) of an inhomogeneous material as a weighed average (f) of the optical constants of its constituents (N₁, N₂, N₃). The experimental AFM data and modeling software was used to calculate the optical spectra of the samples assuming various oxidized states of the nanoparticles. The oxidized state of the particles appears to cause distinct features in the optical spectra. The results of these analyses will be discussed.
12:00PM SM5.00011 Organization and assembly of microstructures using optical tweezers and in-situ two-photon polymerization, NINAD INGLE, SAMARENDRA MOHANTY — Precise manipulation and organization of objects at microscale using optical tweezers has led to new discoveries in colloidal physics and material science in last two decades. However, long-term stabilization and integration of the optically assembled structures in absence of laser tweezers beam requires precise polymerization of the matrix. Here, we report two-photon polymerization induced assembly of microscopic objects being organized by optical tweezers. A tunable cw Ti: Sapphire laser beam was coupled to the laser port above the epifluorescence port of an inverted microscope in order to trap and organize fluorescence microspheres embedded inside photopolymerizable resin following which the laser beam was modelocked in order to initiate two-photon polymerization. Nanonics Multiview piezo stage enabled controlled scanning of the sample. Further, the laser beam was spatially-structured into an elliptic profile by use of a cylindrical lens in order to trap multiple objects simultaneously and stitch them together with the two-photon polymerization process. Use of such micro-assembled structures in Nanophotonics and cellular manipulation will be presented.

12:12PM SM5.00012 An NMR Examination of Synthetic Consolidated Porous Media and Natural Unconsolidated Porous Media, CALEB BAHR, Texas Lutheran University, RYAN PATTERSON, Texas A&M University, LORNE DAVIS, Texas Lutheran University — The object of our experiment included using Nuclear Magnetic Resonance (NMR) to find the signal amplitude and relaxation times of our consolidated (solid) samples and to determine topsoil moisture behavior in our unconsolidated (clay and sand) samples. For all of our samples, we found that the experimentally discovered NMR relaxation times represent the pore size of the sample. We also found that the amount of water within the pores is directly proportional to the amplitude of the NMR signal. We also found that NMR relaxation times are proportional to the grain size as well as the pore size of the unconsolidated particles and that the NMR amplitude is not only affected by the amount of water in the pores, but also detects the water within the interstitial spaces of clay granules.

Saturday, October 23, 2010 10:00AM - 11:48AM — Session SM6 AAPT and Physics Education University Center III Hidalgo Room, 2nd floor - Rafael Lopez-Mobilia, University of Texas at San Antonio

10:00AM SM6.00001 Hands-On Research School in Africa, HARRY L. SWINNEY, University of Texas at Austin — A UNESCO/ICTP-sponsored “Hands-On Research in Complex Systems” school was held 1-12 August 2010 in Cameroon for young science faculty in Africa (see handsonresearch.org). Fifty participants from 17 African countries were selected from a pool of more than three hundred applicants. The goal of the school was for the participants to learn to use modern inexpensive instrumentation (such as webcams) and computational techniques to study diverse phenomena in physics, chemistry, biology, and engineering. The hands-on laboratory sessions were led by 12 senior faculty (most from the US); each faculty member brought a graduate student to assist with the teaching. In addition to the laboratory and computational activities, the participants also learned peer instruction teaching methods, developed oral communication skills in interactive sessions, and learned how to do simple inexpensive classroom demonstrations. This talk will show pictures from the Cameroon Hands-On School and will present plans for similar schools in developing countries in Asia, Latin America, and the Mideast.

1Supported by UNESCO/ICTP, NSF, and NLNG

10:12AM SM6.00002 An online and integrative computer-based approach to improve students' learning in a large introductory physics course, KWAN CHENG, MEHMET CAGLAR, Texas Tech University — It is always a challenge to monitor, gauge and assess the students’ learning activities before, during and after lecture teaching in a large (more than 150 students) introductory physics class setting. At Texas Tech, an online and integrative computer-based approach of using an interactive pre-lecture tutorial, an in-class real-time concept test assessment using a wireless student response system and a homework/tutorial system has been implemented to meet the above challenge in Fall 2010. The strategies of implementation of this integrative approach and how this approach may create synergism of lab and lecture teaching efforts will also be discussed.

1This project is supported by the NIH grant 5RC1GM090897-02.

10:24AM SM6.00003 Investigating the Spatial Abilities of Students Taking Physics in Community College, M.R. HOSSU, North Lake College, Irving, TX, USA, X. CID, R. LOPEZ, Department of Physics, The University of Texas at Arlington, Arlington, TX, USA — Two independent tests that involve spatial visualization abilities, the PFT (Paper Folding Test) and the MRT (Mental Rotation Test) were given to different sections of introductory level physics students. The results show a strong correlation between the results of the two tests regardless of the different level of mathematics used in instruction (algebra or calculus). A statistically significant difference was found for both tests between the summer semester students (mostly 4-year university students) and the fall semester students (mostly community college students). No correlation was found between the PFT or MRT and FCI (Force Concept Inventory).

10:36AM SM6.00004 Creating a community of physics teachers and an environment that rewards thoughtful innovative instruction, ALEX BARR, University of Texas at Austin — In Fall 2009 a small group of physics graduate students at the University of Texas at Austin founded a weekly seminar/discussion group known as the Physics Education Forum. The primary goals of the forum are to help establish a community of students and faculty with a particular interest in teaching and in physics education research, to promote discussions and collaborations on teaching throughout the department, and to explore ways to incorporate research-based teaching methods into our classrooms. In this talk I will describe the formation of the Physics Education Forum and how we were able to quickly establish the forum as a legitimate seminar series within the department. I will also highlight some of the difficulties and successes we faced during the first year of the forum as well as the forum’s impact on the department as a whole and our current efforts to expand the Physics Education Forum.

10:48AM SM6.00005 Laboratory Pedagogy: Fusing traditional and research-based labs, BETH THACKER, KEITH WEST, Texas Tech University — We present research on traditional and research-based labs and discuss the development of new labs which fuse both traditional and research-based laboratory components.

1This project is supported by the NIH grant 5RC1GM090897-02.
11:00AM SM6.00006 A question about anti-reflective coating, LIANXI MA, Blinn College, BAOTING LIU COLLABORATION — We discuss the electric fields and light energy reflected by anti-reflective coating and the interference of the electric fields. By emphasizing that the light energy is determined by the total, rather than individual, electric field, we clarify the confusion about how the anti-reflective coating increases the transmission energy. An example shows that the main electric fields of destructive interference on a coated surface are from the first and second reflections.

11:12AM SM6.00007 What is the Matter?, JAMES M. ESPINOSA, Texas Woman’s University, JAMES ESPINOSA, Rhodes College, JAMES WOODYARD, West Texas A&M University — For the past ten years, we have studied how to utilize Newtonian physics to study macroscopic and microscopic phenomena that most physicists believe necessitate the use of Einstein’s theories of relativity and Quantum Mechanics. We have found other different approaches than ours also. In the spirit of awakening greater interest in diversity of ideas and also examining the philosophical underpinnings of physics, we will present a matrix classification system that will allow ease of presentation of the myriad ideas that have been used by various groups. The purpose of this talk is to show that great strides have been made by research groups in many different areas of physics without using “mainstream” physics. From our personal experience, we have seen that students become very interested in seeing these other avenues briefly described. It also is good to reexamine the basis of both relativity and quantum mechanics, which are the foundation of modern physics.

11:24AM SM6.00008 A NASA Center for Astronomy Education (CAE) Texas Regional Teaching Exchange: Our Second Attempt, W. LEE POWELL JR., Texas Lutheran University, GREG SHERMAN, Collin College, NASA CENTER FOR ASTRONOMY EDUCATION COLLABORATION — The NASA Center for Astronomy Education (CAE) is dedicated to improving the quality of instruction in the astronomy 101 classroom environment. One tool that the CAE is using in this endeavor around the country is the regional teaching exchange. The idea behind the exchange is to get together people who have attended a CAE teaching workshop or would like to know what goes on at one, to talk about techniques they use in their own classroom and to hear about the available teaching tools coming out of the Astronomy Education Research community. The regional exchanges help build a local community of educators to share ideas, give advice, and perhaps work together on education research of their own. In this talk I will discuss our first attempt to hold an exchange in Texas and what we learned from its failure. I will also announce the details of our upcoming second exchange attempt. The next Texas exchange will be held in the DFW area in February. We will offer a teaching workshop, and are accepting papers to be presented at the exchange.

11:36AM SM6.00009 Intuitive Solutions to Relativistic Paradoxes, LIONEL D. HEWETT, Texas A&M University-Kingsville — Einstein’s special theory of relativity is filled with so many apparent paradoxes that many people simply cannot accept its validity. They cannot believe that any theory filled with so many conceptual inconsistencies could possibly correlate with true reality. However, it is not the Theory of Relativity that is filled with paradoxes and inconsistencies but a person’s intuitive interpretation of that theory. By simply changing one’s perspective or viewpoint it is possible to acquire intuitive solutions to many of relativity’s apparent paradoxes and to remove various conceptual inconsistencies commonly associated with the theory. This presentation illustrates how that intuition can be applied to such apparent paradoxes as the twin paradox, the pole-and-barn paradox, and even various paradoxes associated with spacetime itself.

Saturday, October 23, 2010 10:00AM - 1:00PM —
Session AAPT5 Building an Electric Guitar from PVC Multidisciplinary Building M5 3.02.14 -

10:00AM AAPT5.00001 Building an Electric Guitar from PVC —

Saturday, October 23, 2010 10:00AM - 1:00PM —
Session AAPT6 Innovative Resources and Merging Ideas in Nuclear Physics Multidisciplinary Building M5 3.02.16 -

10:00AM AAPT6.00001 Innovative Resources and Merging Ideas in Nuclear Physics