physcon

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POSTER ABSTRACTS

Unifying Fields

Science Driving Innovation

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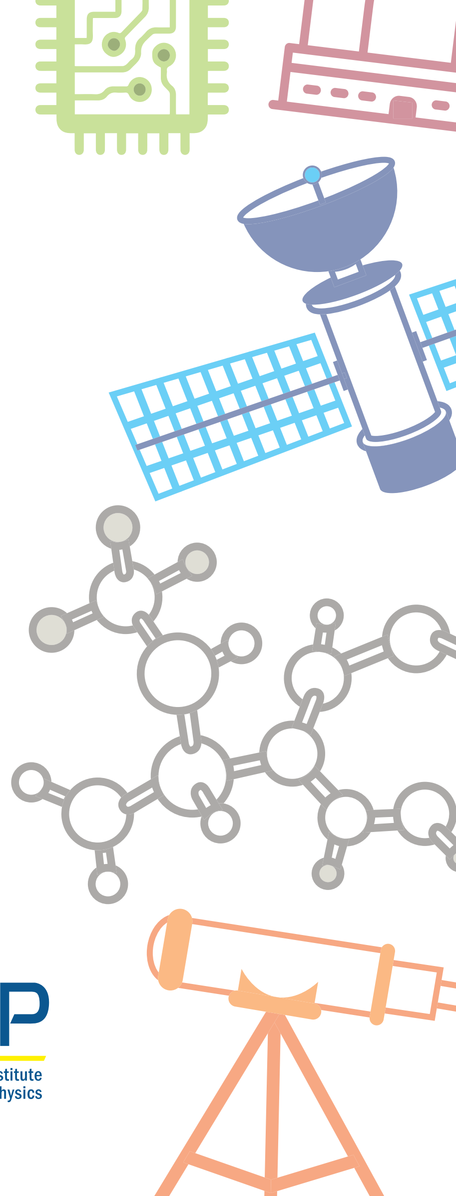

SPS

AIP
American Institute of Physics

Friday, November 4 - Session I

SI - 1 Ilona Tsuper, Cleveland State University, *Light Scattering Characterization of Elastin-Like Polypeptide Trimer Micelles.*
Elastin-Like Polypeptides (ELP) can be used to form thermoreversible vehicles for drug delivery systems. The ELP nanoparticles are composed of three-armed star polypeptides. Each of the three arms extending from the negatively charged foldon domain includes 20 repeats of the (GVGVP) amino acid sequence. The ELP polymer chains are soluble at room temperature and become insoluble at the transition temperature (close to 50 C), forming micelles. The size and shape of the micelle is dependent on the temperature and the pH of solution, along with the concentration of the Phosphate Buffered Saline (PBS) solvent. The technique of Depolarized Dynamic Light Scattering (DDLS) was employed to study the structure and dynamics of micelles at 62 C; the solution was maintained at an approximate pH level of 7.3 - 7.5, while varying the concentration of the solvent (PBS). At low salt concentrations (< 15 mM), the micellar size is not reproducible due to unstable pH levels, arising from low buffer concentration. At intermediate salt concentrations (15 - 60 mM), the system formed spherically-shaped micelles, exhibiting a steady growth in the hydrodynamic radius (Rh) from 10 to 21 nm, with increasing PBS concentration. Interestingly, higher salt concentrations (> 60 mM) displayed an apparent elongation of the micelles evident by a significant VH signal, along with a surge in the apparent Rh. A model of micelle growth (and potentially elongation) with increase in salt concentration is considered.

SI - 2 William Vernon, Randolph College, *The Construction and Optimization of an Erosion Microcosm*
The Gust Microcosm is a scientific instrument used for environmental testing and functions by creating a uniform shear stress over a submerged sample to determine its properties. The cost of a commercial machine is close to $20,000 from a specialized manufacturer while the components and materials can be bought for less than $2,000. The goal of the project was to build a microcosm for Randolph College. During the Summer Research Program, we focused on the control systems for the electric motor and pump that are used to produce the uniform shear stress. Over the course of the program, a PID control system was determined to be the best option for precise control, the entire system was designed, and partially built. The system still needs to be completed and tested before optimization of the microcosm can begin.

SI - 3 Nikolaos Dokmetzoglou, Davidson College, *Implementation of Recursion Relations in Gluon Scattering Amplitude Calculations in AdS(4)/CFT(3)*
Scattering amplitudes are observables that help us probe our theories of fundamental particle interactions in high energy physics. Gluons, being the exchange particles associated with the strong nuclear force, which holds quarks together to form protons, are abundant byproducts of proton-proton collisions. Thus, knowing how to calculate gluon scattering amplitudes for large gluon assemblies is especially useful for identifying the byproducts of collisions at proton-proton colliders, like the Large Hadron Collider. Traditionally, Feynman diagrams have been used to calculate such scattering amplitudes by summing over all the possible ways a certain particle assembly can interact. However, the number of Feynman diagrams one has to consider increases faster than factorially with the total number of particles in the assembly. Fortunately, recursion relations have recently simplified these calculations significantly. The Anti-de Sitter/Conformal Field Theory correspondence is a promising relationship between a theory of gravity in curved-space (AdS) and a quantum field theory in flat-space (CFT), which has lately given physicists hope for a quantum-gravity unification in flat-space. We use recursion to calculate multiple four-point gluon scattering amplitudes in AdS(4)/CFT(3) as sums of products of three-point amplitudes. We finally calculate a five-point gluon scattering amplitude in AdS(4)/CFT(3) by decomposing it into a sum of products of these four-point and three-point amplitudes.

SI - 4 Ryan Hegedus, High Point University, *The EREBOS Project: Studying the Effects of Substellar Companions on Stellar Evolution*
HW Vir systems are binary systems containing a hot subdwarf star and a smaller companion red dwarf star. Previously, there were only 15 known HW-Vir binaries until light curves from the OGLE Survey revealed 36 new such systems. The smaller, cooler companion in each of these systems has survived engulfment by a nearby red giant star. Thus, analyzing the companion mass distribution of HW Vir systems could reveal whether brown dwarfs or even planets can survive engulfment by a red giant. The EREBOS Project was started to obtain follow-up observations of the new binaries discovered by OGLE. The ultimate goal of EREBOS is to find a lower mass limit for these systems. Using the Goodman Spectrograph (SOAR 4m telescope) and the SMARTS 0.9m telescope, we were able to collect time-series photometry and spectra for four of the EREBOS targets. We wrote photometry and spectral analysis code in Python to extract light curves and orbital velocities. The data were then modeled with the software Binary Maker in order to obtain all stellar parameters, most importantly the companion mass. Our initial results imply that brown dwarfs may be able to survive red giant engulfment.

SI - 5 Patricia Kobak, Brigham Young University-Idaho, *Search for X-ray Channeling Radiation at FAST*
Channeling Radiation (CR) is generated by charged beams passing through a crystal parallel with a crystallographic plane. Electrons in the crystal may oscillate perpendicular to the plane and generate CR which propagates in the same direction as the incident beam. Electron beams with moderate energy ranging from 4 to 50 MeV can be used to produce Channeling Radiation. The beam experiment at Fermilab Accelerator Science and Technology (FAST) facility will have a beam energy of 50 MeV, and offers the possibility of a precise, tunable X-ray source. This X-ray source can be used in a variety of applications, from medical imaging to material science studies.

SI - 6 Arvind Srinivasan, St. Mary's College of Maryland, *Magneto-Optical Trapping of 85Rb and its Applications for Gradient Magnetometry*
We continue an existing experiment at the Patuxent River Naval Air Station to investigate the magnetometry applications of magneto-optical cooling and trapping. We start by forming a magneto-optical trap (MOT), which consists of a high-density, low-kinetic energy sample of atoms, in this case 85Rb. We then perform an optical toss on the MOT while probing the sample with another laser beam, the Raman laser beam. A sequence of Raman laser pulses creates an atom interferometer. The interference represents a high-precision measurement of the magnetic splitting of the atomic energy levels, which can be used to measure the magnetic field gradient. We also magnetically shield the experiment to reduce magnetic noise, implement a phase lock for the Raman laser frequency, improve the loading time of the MOT, and show two Raman spectra taken simultaneously via a dark spot MOT experiment. The current overarching goal for the experiment is to be able to take data with T^3 sensitivity instead of the T^2 sensitivity found in current atom interferometers.

SI - 7 Justin Landay, George Washington University, *Model Selection in the Analysis of Photoproduction Data*
Scattering experiments provide one of the most powerful and useful tools for probing matter to better understand its fundamental properties governed by the strong interaction. As the spectroscopy of

the excited states of nucleons enters a new era of precision ushered in by improved experiments at Jefferson Lab and other facilities around the world, traditional partial-wave analysis methods must be adjusted accordingly. In this poster, we present a rigorous set of statistical tools and techniques that we implemented; most notably, the LASSO method, which serves for the selection of the simplest model, allowing us to avoid over fitting. In the case of establishing the spectrum of exited baryons, it avoids overpopulation of the spectrum and thus the occurrence of false-positives. This is a prerequisite to reliably compare theories like lattice QCD or quark models to experiments.Here, we demonstrate the principle by simultaneously fitting three observables in neutral pion photo-production, such as the differential cross section, beam asymmetry and target polarization across thousands of data points.

SI - 8 Kaydian Quintero, St. Mary's University, *Undergraduate Laboratory Exercise Involving CdSe Quantum Dots*
The aim of this project is to develop an undergraduate laboratory experiment for a modern physics laboratory course involving the synthesis of cadmium selenide quantum dots (CdSe) and calculation of dot sizes. The lab module is intended for sophomore level physics majors or minors and supplements the modern physics lecture component which introduces quantum mechanics. The synthesis procedure requires relatively low reaction temperatures and safer chemicals as well as a simpler extraction procedure allowing for an easier obtainment of dots of varying sizes. Using a spectrofluorophotometer, the fluorescence wavelengths of the dots can be measured, and along with the simple infinite potential well model (particle-in-a-box), which is covered in lecture portion of class, the quantum dot sizes can be calculated to a reasonable level of accuracy. We were able to successfully synthesize CdSe quantum dots of radii ranging from 1.73 to 3.09 nm which are all smaller than the CdSe Bohr exciton radius of 5.6 nm and thus exhibit strong quantum confinement effects.

SI - 9 Amanda Menechella, University of Toledo, *Outflow and Infall Toward the Youngest Protostars in Orion*
In the early stages of star formation, bipolar molecular outflows are present around the young stellar core and are still not widely understood. We aim to further characterize very young Class 0 protostars. We check for infall asymmetry in key molecular lines of HCO+, H13CO+, and NH3. CO (3-2) and (4-3) maps of 16 very young Class 0 protostars were obtained using the Atacama Pathfinder EXperiment(APEX) telescope. We estimated physical properties, such as masses and forces, for these outflows in LTE approximation. We estimated the outflows masses and forces based on the CO (3-2) and (4-3) line intensities for 10 sources with clear outflows detections and upper limits for the outflows masses and forces of the 6 sources without apparent outflows. The outßow masses range between 1.4 ×10 −2 and 4.3×10 −2 M⊙ for CO (3-2), and between 0.23 and 0.60 M⊙ for CO (4-3), assuming an excitation temperature of 75 K. The outflows forces range between 8.1×10−4 and 3.1× 10−3 M⊙ km s−1 yr−1 for CO (3-2) and between 9.1×10−4 and 2.3×10−3 M⊙ km s−1 yr−1 for CO (4-3). Most sources show an infall asymmetry based on the observed HCO+, H13CO+, and NH3 lines. The derived outflows forces for the detection sources are similar to those found for other class 0 protostars suggesting that outflows evolve rapidly in the class 0 stage. The outflows forces of our sample show no correlation with the bolometric luminosity, unlike those found by some earlier studies for other class 0 and class I protostars.

SI - 10 Michael Seitanakis, Washington University in St. Louis, *Strong Coupling of a Spin Ensemble in Ruby Crystal to a Three-Dimensional Copper Cavity*
In the pursuit of developing quantum technology, researchers study novel ways to measure and control quantum phenomena. For example, if strong enough coupling is attained with the spin ensemble in a ruby crystal that has a small enough linewidth, this system could serve in a quantum computer as a quantum memory. Previous research has shown strong coupling to spin ensembles, but achieving a smaller spin linewidth is required to create quantum memory devices. This study examines the coupling between a spin ensemble and a double post reentrant three dimensional copper cavity, which could take advantage of its higher mode volume and a more constant magnetic field through the ruby volume to achieve higher coupling and a smaller spin linewidth. Measuring the transmittance through the cavity, the change in quality factor, Q, and resonant frequency of the cavity indicate coupling strength, g, and the spinlinewidth, γ. As the advent of the quantum computer nears, this research adds to the body of work that attempts to access "the vast expanse of Hilbert space."

SI - 11 Mercedes Mansfield, Grove City College, *Developing a Taxonomy of Student's Alternative Conceptions on Buoyancy*
Numerous studies, dating back at least as far as Piaget, have used buoyancy to probe students' understanding of density. Few studies have instead probed students' understanding of buoyancy in terms of floating and sinking behavior, buoyant force, and Archimedes' Principle. Our research group has identified over 150 unique student conceptions about buoyancy and have organized these into a taxonomy. This poster will present on the process of identifying the conceptions and creating the taxonomy. We will discuss how the misconceptions included on the taxonomy were selected based on our own work and that by others, and describe the multiple-coder process we used to maximize accuracy when categorizing the conceptions.

SI - 12 Jaclynn Lewis, Texas Lutheran University, *Family Physics Night at Texas Lutheran University*
For the past four years, the Texas Lutheran University Physics department has hosted an event that attracts hundreds of people of all ages to the TLU campus. Last year over 400 visitors participated in a celebration of the international year of light. SPS students provided several hands-on activity stations and presented an exciting demonstration show. This event draws participation from a large primarily rural geographic area and has garnered the attention of high school physics teachers who send their students to the event for enrichment.

SI - 13 Grace Holling, Texas Lutheran University, *SYS-STEM: Future Faces of Physics at Texas Lutheran University*
In the spring of 2016, the Texas Lutheran University chapter of SPS was awarded the Society of Physics Students Future Faces of Physics award for a unique outreach program, "SYS-STEM". The purpose of our outreach was to introduce at-risk children in the local area to creative applications of physics and show them how physics can be fun. Working in partnership with Seguin Youth Services (SYS), a non-profit after-school program, we hosted four on-campus lab events and one visit to the youth center. This unique outreach program allowed for the formation of long term relationships between undergraduate student presenters and K-12 participants.

SI - 14 Zhaojia Xi, Abilene Christian University, *Study of the trigger efficiency for SeaQuest Drell-Yan Dimuons*
The SeaQuest (E906) experiment, using the 120 GeV proton beam from the Main Injector at the Fermi National Accelerator Laboratory (FNAL), is studying the quark and antiquark structure of the nucleon using the Drell-Yan process. SeaQuest uses a two magnet focusing spectrometer with four detector stations that include fast plastic scintillator hodoscope planes. The hodoscope arrays along with Field Programmable Gate Arrays(FPGAs) are used to make the SeaQuest trigger system. It is designed to measure events with dimuon pairs

from the Drell-Yan process. The signals from each hodoscope, which have adequate timing resolution to determine which 18.9 ns beam pulse the event occurred, are sent to the FPGA trigger modules. In order to get a correct hit patterneach channel is aligned to the beam RF clock. The trigger is formed when the hits fulfill a dimuon pattern. A program has been developed to analyze and calculate trigger efficiency by using data from hodoscopes. It is important to study trigger efficiency to be used in physics results such as the cross section of the Drell-Yan process. The method programming, measurements.

SI - 15 Alan Vasquez Soto, High Point University, *There and Back Again?: The Disappearing Pulsations of CS 1246*
Hot subdwarf stars were once main sequence stars, like the sun, that deviated from normal stellar evolution due to binary interactions and evolved into extreme horizontal branch stars. Several of these stars exhibit rapid pulsations driven by iron opacity variations. CS 1246 is a rapidly pulsating hot subdwarf discovered in 2009 that is dominated by a single 371 second pulsation. At the time of its discovery, the pulsational amplitude was one of the largest known, making CS 1246 an ideal candidate for follow up studies. Observations in 2013 implied that the pulsational amplitude had decreased significantly. Since then we have continued monitoring the star using the robotic SKYNET telescopes in Chile, in order to further characterize any changes. Our recent observations show that the pulsational amplitude has gone down by a factor of six: CS 1246 is barely a pulsator anymore. The decay in amplitude over time is reminiscent of a damped harmonic oscillator. Here we present six years of photometry for CS 1246 and discuss possible scenarios that might explain its interesting behavior.

SI - 16 Luis Royo Romero, High Point University, *Functionality of Chloroform Treatment to Improve Adhesion of Deposited Au Thin Films on PMMA*
The deposition of Au thin films onto polymer surfaces is a crucial step in the manufacture of a variety of microfabricated devices including displays, microelectronics, biomedical and microfluidic devices. Au is characterized by having high electrical and thermal conductivity making it a good choice for micro-electrodes. However, due to its relative chemical inertness, it is difficult to fabricate on polymeric substrates due to the low adhesion to polymer's surface. Previous experiments have studied various methods to improve the adhesion of vapor-deposited Au thin films onto poly (methylmethacrylate) (PMMA). In this study, we deposit 14 nm of Au onto 1.50 mm thick PMMA via magnetron sputter deposition and exposed the samples to a chloroform vapor in a chamber at 70¡C using a hot plate. The force required to remove the Au thin film is quantified as a function of the polishing force and the transmittance acquired using UV-VIS spectroscopy. Conducive of the data confirming the effectiveness of chloroform post-treatment, we conducted a study on selective pattering by isolating regions using PDMS masks and attaining quantitative data by pixel counting using a Matlab script. Both methods of data collection demonstrate a similar inverse relation between the reduction of Au on the PMMA and the incremental of applied force, displaying the potency of chloroform exposure.

SI - 17 Padraig Clancy, High Point University, *Extremely Close Binaries from K2 Data*
The Kepler 2 mission has provided light curves for many systems, some of which are indicative of having a dense primary star and a less dense secondary star such as would be present in a A+WD or EL-CVn type system. Patterns indicative of ellipsoidal deformation and Doppler boosting can be seen in the light curves of these systems. This indicates a very close orbit as well as very high orbital velocities. We followed up Kepler 2 photometry with high resolution spectroscopy from CHIRON at the SMARTS 1.5 meter in order to determine the system compositions. Here we present on two of these systems.

SI - 18 Patricia Snow, Texas Lutheran University, *Quality Aspects of Locally Purchased Honey*
Honey is a highly dense and viscous liquid made most commonly by bees through the process of regurgitation and evaporation. Honey's sweetness stems primarily from the chemicals fructose and glucose. Very few microorganisms can thrive within honey because of the lack of water. A variety of locally-produced honey was examined in order to test quality standards established by the International Honey Commission (IHC). Several aspects established by IHC were analyzed, including moisture content, specific gravity, diastase activity, free acidity, hydroxymethylfurfural (HMF) content, elemental composition, electrical conductivity and presence of commercial invert sugar. It was found that diastase activity was below minimum standards, commercial invert sugars were present in a large number of the samples, and most honeys contained over the maximum suggested amount of HMF as recommended by the IHC and listed in the Codex Alimentarius Standards.

SI - 19 Jeremiah Moskal, Colorado Mesa University, *Bringing Gamma Ray Burst Dynamics to the Public Using Python*
Gamma Ray Burst dynamics have long been traditionally modeled using the semi-analytic approximations of Sedov (46) and Taylor (41) as well as Blandford and Mckee (76). This work presents the initial results of a python code that is being developed to trace the relativistic to non-relativistic evolution of a GRB explosion. The code aims to remove several approximations made in the afore mentioned semi-analytic formalisms and replace them with numerically calculated and more precise results. This code, when completed will be released to the open source astronomical community as a tool for GRB research. Initial results as applied to non-relativistic supernovae will be presented as well as currently occurring modifications to the code.

SI - 20 Matthew Iczkowski, High Point University, *Mirco- and Macrorheology of Agarose for Use as a Potential Mucus Simulant*
The study of mucus simulants plays an important role in the creation of innovative treatments for people who suffer from pulmonary illnesses, such as cystic fibrosis, and in obtaining a deeper understanding of lung function in general. Creation of a simulant with a rheological profile similar to mucus would provide scientists with a model fluid for drug delivery and clearance studies, in addition to being more readily available and easily acquired than native lung mucus. Many of the mucus simulants currently investigated in the literature include locust bean gum, xanthan gum, and guar gum. We are investigating the polysaccharide agarose as a potential mucus simulant, and have rheologically characterized varying concentrations of agarose solutions using passive microbead rheology with 500 nm fluorescent beads. The viscoelastic moduli and diffusive properties of each concentration were analyzed, and the data showed that as agarose concentration increased, the elastic modulus dominated. These results were combined with cone and plate rheometer data of the same concentrations of agarose. By comparing microscopic and macroscopic results, we obtain a better understanding of how agarose behaves at the critical length scales at which mucus functions. Future research will be conducted into understanding the temperature dependence of the micro- and macrorheological properties of agarose and its suitability as a mucus simulant.

SI - 21 William Helmer, University of San Diego, *Epicatalysis, Energy, and the Second Law of Thermodynamics*
Epicatalysis is a recently identified form of catalysis that could have wide ranging applications for chemical manufacturing and energy production. Epicatalysis is the catalytic process in which gas-surface reactions cause a steady state non-equilibrium of gas phases. Until now all known experimental examples have occurred exclusively at high temperature (i.e., T > 1500 K), though theory indicates that a room-temperature version should be possible using either van der

Waals dimers or hydrogen-bonded dimers interacting with polymeric substrates. During summer 2015 we explored room-temperature candidates by exposing test surfaces to low-pressure test gases using an original apparatus of our original design. Initial results with teflon and kapton surfaces and formic acid gas demonstrated the first examples of room-temperature epicatalysis.

SI - 22 Nikita Rozanov, Oregon State University, *Ultrafast structural snapshots of the GFP chromophore in solution*

The role of fluorescent proteins as biomarkers has provided decades of valuable research insights for the scientific and engineering community. The Green Fluorescent Protein (GFP) has long been a favorite for bioimaging owing to its bright fluorescence and high quantum yield. Its success has inspired bioengineers to modify the chromophore's structure and environment to create many new fluorescent proteins with better properties. Despite the large success of engineered GFP derivatives, the interplay between chromophore fluorescence and local environment is not well understood. Notably, no definitive theory can explain why the GFP model chromophore 4-hydroxybenzylidene-1,2-dimethylimidazolinone (HBDI) does not significantly fluoresce when taken out of the protein pocket.

Using femtosecond stimulated Raman spectroscopy (FSRS) we study the molecular motions that compete with fluorescence when HBDI is in solution. We pioneer a new 2D Raman approach for comprehensive visualization of anharmonically coupled vibrations. Using this method we uncover an out-of-plane motion coupled to other normal modes providing compelling evidence for conformational twisting in HBDI after photoexcitation. Further analysis indicates that HBDI approaches a conical intersection from a twisted internal charge transfer (TICT) state appearing on a ~2.0 ps timescale after a ~500 fs internal conversion. Additionally studying the effects with a viscous glycerol solvent reveals how different environments can significantly alter the efficacy of nonradiative relaxation pathways. These findings reveal the active motions that govern the fate of the GFP chromophore in solution, and correlate their appearance with the chromophore's environment.

SI - 23 Haley Stien, Abilene Christian University, *Comparing Novel Multi-Gap Resistive Plate Chamber Models*

Investigating nuclear structure has led to the fundamental theory of Quantum Chromodynamics. An Electron Ion Collider (EIC) is a proposed accelerator that would further these investigations. In order to prepare for the EIC, there is an active detector research and development effort. One specific goal is to achieve better particle identification via improved Time of Flight (TOF) detectors. A promising option is the Multi-Gap Resistive Plate Chamber (mRPC). These detectors are similar to the more traditional RPCs, but their active gas gaps have dividers to form several thinner gas gaps. These very thin and accurately defined gas gaps improve the timing resolution of the chamber, so the goal is to build an mRPC with the thinnest gaps to achieve the best possible timing resolution. Two different construction techniques have been employed to make two mRPCs. The first technique is to physically separate the gas gaps with sheets of glass that are .2mm thick. The second technique is to 3D print the layered gas gaps. A comparison of these mRPCs and their performances will be discussed and the latest data presented.

SI - 24 Caleb Nasman, Grove City College, *A Simple Molecular Dynamics Simulation for Teaching Chemical Thermodynamics*

We are developing a molecular dynamics simulation using Python that is designed to help students gain an intuitive understanding of the connection between particle motion and interactions at the microscopic level with macroscopic thermodynamic properties. In the simulation the particles are in a uniform external force field and are confined by walls to remain inside two interconnected compartments. This system is analogous to a simple chemical system composed of a reactant separated by an energy barrier from a product. Using a graphical user interface, students will be able to control various parameters in the simulation to explore and visualize how these quantities affect reaction equilibrium, reaction rate, and thermodynamic properties such as the enthalpy, entropy, and free energy of the analogous reactant, product, and transition state.

SI - 25 Sarah Monk, University of Maryland, *Identifying impurities in liquid Xenon through super-cold trap*

Driven by the operation of the Large Underground Xenon Experiment (LUX)the Super-Cold Trap was designed to find traces of impurities in liquid xenon through variable temperature manipulation. LUXa dark matter detector experimentallows 3D positioning of interactions occurring within its active volume of liquefied ultra-pure xenon. Xenon is a scintillator: interactions inside the xenon will create an amount of light proportional to the amount of energy deposited. In order to be an effective scintillatorthe xenon must be as pure as possible in order to avoid background radiation. In order to test the purity of the xenona residual gas analyzer (RGA) is used. The RGA must be used for near-vacuum applications resulting in much of the xenon gas being frozen using liquid nitrogen. This method has been moderately successfulhowever the constraint of using only one temperature limits the ability to identify impurities. The super-cold trap utilizes a liquid helium system to cool the xenonand heaters attached to the copper trap to vary the temperature in order to reduce the partial pressure of the xenon and find smaller traces of impurities. The successful design and construction of the supercold trap has been completedletting us test the effects of the cryogenic and heater systems. These results will allow us to accurately identify the impurities in the xenon through future tests."

SI - 26 Sarah Kerr, University of Maryland - College Park, *Quantitative Analysis of Microtubule Tip Dynamics and Actin Flow during T Cell Activation*

T lymphocytes are an integral part of the body's immune response. T cells are activated when their receptors bind to antigens on the surface of antigen presenting cells. This binding triggers a signal transduction cascade which eventually results in the polymerization of actin and the formation of the immunological synapse. As part of this formation, the microtubule organizing center migrates to the contact region and microtubules are polymerized towards the perimeter of the cell.

The tips of growing microtubules were fluorescently tagged and imaged in conjunction with actin in Jurkat T cells while they were on an antigen coated surface which initiated activation. Total internal reflection fluorescence microscopy was used to properly image the region of interest for immunological synapse formation. Videos were taken of the fluorescently excited proteins at a rate of 1 fps to accurately record actin and microtubule tip dynamics during immunological synapse formation.

The speeds of the microtubule tips and the retrograde flow of actin monomers were computed from the videos. The results show that microtubule tips display different behavior in cells under normal conditions when compared with cells exposed to ck-666. Ck-666 inhibits the Arp-2/3 complexan actin nucleation protein. This indicates a relationship between actin and microtubules during the activation process."

SI - 27 Amy Parker, Ithaca College, *Microplastics: A Toxicology and Characterization Study using Fluorescence Microscopy*

Plastic is everywhere nowadays. Not only are small plastic particles are found in our toothpaste and soap, but all plastic degrades under natural forces and sunlight. Studies have shown that filter feeders in aquatic systems eat these small plastics, which transports plastic up the food chain. By identifying and characterizing the size, shape and types of plastic in personal care products using fluorescence microscopy, we are better able to understand how the ecosystem will react to these plastics. What is new here is that these plastics have never been characterized before using fluorescence, and also have not been studied with respect to Cayuga Lake in Upstate New York. Since this problem relates to the food chain, the toxin absorption and emission of these plastics is also being studied, using environmentally relevant concentrations of toxins, such as BPA. Our results agree with studies, indicating that micro plastics absorb and emit toxins, and in the long term these plastics pose a threat to not only the studied Cayuga Lake ecosystem, but all ecosystems that plastics are around.

SI - 28 Aman Kar, University of Wyoming, *Remotely Automated Observations of Transiting Exoplanets*

The goal of this research is to perform remotely operated automated observations of transiting exoplanet candidates cataloged by the KELT (Kilodegree Extremely Little Telescope) Collaboration. We have been using University of Wyoming's Red Buttes Observatory which has a 0.6-meter telescope. We have been using a software program designed in Python to help conduct observations with no human interaction. The program only requires the details of the event to be entered and it automatically conducts the nightly observations including the startup and shutdown procedures of the observatory. Being a part of the KELT collaboration, we have been granted access to an extensive database of potential exoplanet candidates. We are also able to compare our data with previous observations by other members of the collaboration and help expand the search for exoplanets.

SI - 29 Jacob Barfield, Roanoke College, *Modeling the Effect of Opioids on the Bursting of Respiratory Neural Networks*

The inspiratory phase of the respiratory rhythm originates in a region of the ventrolateral medulla known as the pre-Bötzinger complex (preBötC). This region contains cells that are silent (S), tonically spiking (T), or intrinsically bursting (B). These different cells work together to produce and maintain the rhythm that controls the body's breathing. Experimental data was collected by one of us (Mellen) on the integrated firing rate of the rat preBötC with and without both methadone and riluzole. The experimental data from riluzole, which is known to be a persistent sodium channel blocker, was used in conjunction with a network model of conductance based neurons to simulate the preBötC in order to narrow down the potential network connectivity (C) and the percent of intrinsic bursters (B) to a few potential candidates. The data from methadone was used in conjunction with the network model to determine the effects of methadone exposure in the womb on the behavior of the rat preBötC. This exploration yielded that exposure to methadone in the womb causes an increase in the strength of the synaptic connections and that it likely affects the calcium channels of the cell.

SI - 30 Emily Anderson, St. Catherine University, *Designing a technique to study cell-to-cell variations in virus production*

It is well known that individual cells exhibit a range of responses to the same external stimulus. Currently, many research techniques allow scientists to study ensemble averages of cellular responses, but few techniques exist that allow scientist to non-invasively study the response of individual cells. In our research we are developing a technique that will allow us to study the cell to cell variation in the timing and number of viruses produced after viral infection. Characterization of differences across a cell population will provide insight into specific cellular mechanisms involved in virus production.

Our technique combines custom built microfluidic devices with fluorescence imaging. The microfluidic chips are fabricated using photolithography. We designed and fabricated multiple different types of single and multiple cell traps. These traps will first be tested using microfluidic beads. Then we will move on to trapping single cells infected with an HIV-1 viral protein and studying the timing and number of viral like particles (VLPs) released per cell. In the future our method could be extended to other cellular variations in response to their external environment.

Cells produce VLPs for approximately 6-48 hours after transfection with the HIV-1 Gag protein. During this time we must be able to keep the cells at 37°C and observe them in real time on the fluorescent microscope. Commercial microscope incubators are availablebut are quite expensive and difficult to customize. We designed a low-cost homebuilt microscope incubator for our research. We will discuss the design and construction process for the incubator."

SI - 31 Riley Malcolm, valencia college, *Michelson Interferometer as a Model of the LIGO Detector in an Introductory Physics Lab*

Gravitational waves were predicted by Albert Einstein a hundred years ago, as explained in his theory of relativity. It was a monumental task to detect them, but it was finally achieved by the LIGO team last year. They used state of the art equipment, but their detector was based on the well-known Michelson Interferometer. I will share my experience of setting up a simple Michelson Interferometer in an introductory physics lab at Valencia College as a model of the LIGO detector. I will present data obtained by observing interference patterns caused by two different laser sources. I will explain how a simple laboratory interferometer can be used to demonstrate basic physics behind the LIGO detector.

SI - 32 Hamna Ali, Towson University, *Extra Dimensions and Violation of Lorentz Symmetry*

We use recent experimental limits on Lorentz violation to obtain new constraints on Kaluza-Klein-type extensions of General Relativity in which extra dimensions may be large but do not necessarily have units of length. Whether or not we detect "motion" (i.e., dynamics) in these new directions then depends on the values of the dimension-transposing constants that convert them into lengths. From these conversions and experimental limits, we see that the associated variation in fundamental quantities, such as rest mass or charge, must occur slowly, on cosmological scales.

SI - 33 Daniel Ally, Valencia College, *The modification of procedure and analysis to improve accuracy for the charge-to-mass ratio experiment*

The electron charge-to-mass ratio experiment is traditional in physics labs across the country, and when students conduct this experiment, they simply follow the instructions in the lab manual. Using the Sargent-Welch e/m apparatus at Valencia College, we decided to look more in depth at the experiment. We performed many trials in order to evaluate what methods in procedure and analysis would improve the accuracy in calculating the e/m ratio. We will share the data we gathered, and using that, we will provide insight on how to modify experimental procedure and analysis.

SI - 34 Sachithra Weerasooriya, Midwestern State University, *Investigating Dwarf Spiral Galaxies*

Several studies have proposed that dwarf elliptical / spheroidal galaxies form through the transformation of dwarf irregular galaxies. Early and late type dwarfs resemble each other in terms of their observed colors and light distributions (each can often be represented by exponential disks), providing reason to propose an evolutionary link between the two types. The existence of dwarf spirals has been largely debated. However, more and more recent studies are using the designation of dwarf spiral to describe their targets of interest. This project seeks to explore where dwarf spirals fit into the above mentioned evolutionary sequence, if at all. Optical colors will be compared between a sample of dwarf irregular, dwarf elliptical, and dwarf spiral galaxies. The dwarf irregular and dwarf elliptical samples have previously been found to overlap in both optical color and surface brightness profiles shape when limiting the samples to their fainter members. A preliminary comparison including the dwarf spiral sample will be presented here, along with a comparison of available ultraviolet and near-infrared data. Initial results indicate a potential evolutionary link that merits further investigation.

SI - 35 Salvador Montes, Colorado University Boulder, *Simulating Fluorescence Recovery After Photo-Bleaching in the Study of Microtubule Dynamics*

Fluorescence recovery after photo-bleaching (FRAP) allows one to study the kinematics of proteins that actively bind onto and dissociate from a microscopic structure such as microtubules (MT), thin tube like figures that are involved in cellular division. FRAP involves targeting a small area of the structure, which are tagged with tiny proteins that are fluorescent or produce light, and exposing it to high intensity light. The input of extensive energy from the light over time will cause that region to go dark or become photo-bleached. However, the light will return gradually because the main proteins with the photo-bleached tags are replaced with new proteins that still have functioning fluorescence tags. Analyzing the time it passes from before photo-bleaching to maximum recovery in light will provide insight in the rates of binding and dissociation of the proteins under study. This project involves using FRAP in order to study the growth and shrinkage of microtubules, which depend on whether their proteins, called tubulin, attach onto or come off the MT. Here, a simulation is currently being devised of MTs undergoing FRAP. When the updated simulation is compared to experimental video data of microtubules under FRAP, then one is able to determine the effect the incoming light has on the dynamics of microtubules as well as compare the associated rates from FRAP analysis to previous values.

SI - 36 Michael Forkner, Oregon State University, *The Seebeck coefficient of the heterostructural alloy Ca(x)Sn(1-x)Se*

The focus of this work is to characterize the properties of the semiconductor alloy CaxSn1-xSe. Thin films are deposited using pulsed laser deposition by combining orthorhombic SnSe and cubic CaSe to form a homogenous heterostructural alloy. X-ray diffraction determines if the sample has phase separated or, if it is homogeneous, then it determines the crystal structure of the homogeneous alloy. We then characterize their electrical properties as a function the alloy composition. We find that any samples created with a deposition temperature above 500 degrees or below 220 ûC are phase separated. In the intermediate temperature range, most films are homogeneous alloys, although some phase separate for other reasons. For the phase separated alloys created at high temperatures, the Seebeck coefficient increased linearly with calcium concentration. For the homogeneous alloys, the Seebeck coefficient decreases with increased calcium concentration from <700 μV/K> at x=0 to <30 μV/K> at x = 0.3 and then increases again at x = 0.4. For samples with a calcium concentration greater than x = 0.4, the resistance is too high to make electrical contact and it is not possible to measure a Seebeck coefficient.

This work was supported as part of the Center for Next-Generation Materials by Design: Incorporating Metastabilityan Energy Frontier Research Center funded by the U.S. Department of Energy Office of Science Basic Energy Sciences under Award # DEAC36-08GO28308."

SI - 37 Dakari Franklin, Morehouse College, *Microfluidic Systems for Continuous Cell Culture*

The integration of an electrochemical pH sensor and a thermistor into a microfluidic system will give scientist the ability to monitor cell culture growth. The criteria for these sensors to be integrated are that they must be thin to fit into the system without disturbing the cell culture, cohesive to be able to not be deteriorated by the cell culture, and to have small dimensions to be integrated into the system at the beginning and the end. A low cost and efficient way to monitor continuous cell culture will help benefit scientist, by increasing the amount of cells during the proliferation phase of cell culture. Monitoring cell culture growth has been done with previous work, but the cost was expensive and now there are looks to make cheaper efficient ways. The electrochemical pH sensor and the thermistor can be implemented using serigraphy, which will decrease cost, while keeping efficiently constant. This process uses DraftSight software to design each element of the system and a screen-printing machine to implement the sensors onto the plastic cartridge. Scientist would use this microfluidic system as a low cost way to monitor their continuous cell culture in order to maximize the number cells their cell culture produces.

SI - 38 Yuhao Qiao, Adelphi University, *Ultra-sensitive, real-time trace gas detection using a high-power, multi-mode diode laser and cavity ring-down spectroscopy*

The real-time measurement of nitrogen dioxide (NO2) to an ultra-high sensitivity has wide applications in the fields of environmental monitoring, explosive detection and medical diagnostics. The cavity ring-down spectroscopy (CRDS) is one of the powerful techniques for this purpose. In CRDS, laser light is passed through a sealed high-finesse cavity containing a gas mixture, in part of NO2. The decay time (τ) of the exiting light corresponds to the attenuation due to NO2 absorption and thus its concentration. CRDS is advantageous in that the concentration measurement is independent of the intensity of the laser. However, most CRDS techniques available are prone to vibration and require mode-matching techniques or experiment conducted in a vibration-free environment. The use of a 1.1W, 400nm, multi-mode diode laser with FWHM of ~0.6nm couples the laser with a multitude of cavity modes which results in a stable cavity signal for on-axis alignment. The improved signal-to-noise ratio regardless of vibration made the device suitable for field-deployment. The measurements are close to real-time—with an integration time of 60μs we obtained a sensitivity of 530 parts-per-trillion (ppt). The optimal integration time is determined using an Allan variance plot. We measured known concentrations of NO2 gas and obtained a sensitivity of 38 ppt with the optimal integration time of 128 ms.

SI - 39 Alexander Haas, University of Wisconsin River Falls, *Neutron Monitor Analysis and Searching for Forbush Decreases*

This past summer, the neutron monitor located in Centennial Science Hall at University of Wisconsin - River Falls was moved from the first floor of the building to the third floor. Analysis was done on the effect that the additional two stories of building had on the neutron detection rates. In addition, software that was built by a prior student to display neutron monitor data was recoded, removing extraneous code and improving the viusal appearance of data. This also included a preliminary subroutine to locate significant drops in the neutron detection rates, which could be correlated to a increase of solar activity, know as a Forbush decrease. Finally, analysis was done on a potential Forbush decrease occuring on June 22nd, 2015, using the data from River Falls and comparing it to several other monitors at similar cutoff rigidities..

SI - 40 Nicholas van Almelo, Loyola University Chicago, *Demonstrating Effective Use of a Base Plate Electrode for Electrospinning of Polyvinylpyrrolidone Nanofibers*

Electrospinning is an incredibly useful fiber manufacturing process. It is typically considered a simple process, but it can become overwhelmingly more complex as attempts are made to control certain characteristics. This research project focused on the process itself rather than its products. The purpose of this investigation was to observe the effects of the addition of an electrode, called the base plate, on an innovative electrospinning setup. The unique setup has a reversed potential bias as in contrast to standard setups. Not only was the goal to observe the base plate's effect, but also quantify it. The additional electrode was predicted to improve the packing density and the shape of the deposition. Packing density (g/cm2) was chosen as opposed to the more common volumetric density (g/cm3) because the calculations for fiber volume can be quite inaccurate and cumbersome.

A standard solution of 8% polyvinylpyrrolidone (PVP) and absolute ethanol (EtOH>99.9% purity) and parameters consistent with reliable electrospinning were used for trials. Trials were run with the same parameters with and without the base plate electrode. After taking measurements of the fiber mat mass and diameter the packing density was calculated. Examination of the data showed a reliable increase in the packing density when the base plate electrode was used. The shape of the mat was considerably more circular in every trial. In the future other researchers can use this innovative method to more easily study effective electrospinningin the pursuit of highly desired up-scaled production."

SI - 41 Matthew Burton, Eastern Michigan University, *Analysis of the Sensitivity of Mars' Neutral Atmosphere to Changes in Solar Output*

In November of 2013, NASA launched a spacecraft which started the Mars Atmosphere and Volatile EvolutioN (MAVEN) mission. The goal of this mission is to collect data from the upper atmosphere of Mars to better understand the processes that control it and the role the that atmospheric loss has played in the changing climate. The focus of this project is on investigating the variability of the neutral atmosphere in response to changes in the solar radiation in the EUV spectrum. This will help in model constraints for the backwards extrapolation of atmospheric loss which is another primary goal of the MAVEN mission. Using density data from MAVEN's Neutral Gas and Ion Mass Spectrometer (NGIMS) and solar irradiance data from the Extreme Ultraviolet (EUV) monitor, the correlation between atmospheric density and irradiance is found for a year-long period. During this year-long period, there are two month-long periods corresponding to high solar activity. These two periods are studied more in depth, adding a sensitivity calculation which measures how much the density changes for the change in irradiance. The objective of this presentation will be to summarize the results of this analysis, and the future direction of this research.

SI - 42 Khyana Price, Alabama A&M University, *Pulsations of a Neutron Star*

Neutron stars are extremely compact objects, resulting from supernova explosions of dying massive stars with masses about 8 to 20 solar masses. Their existence in nature was theoretically predicted in the 1930s and observationally discovered until the 1960s from the measurement of unusual pulse-like radio emissions from the Crab Nebula. Conventionally, the pulse-like emissions are explained based on the lighthouse model of pulsars as fast rotating neutron stars. According to this model, the ON and OFF phases of a pulsar refers to the beam of radiation pointing to the Earth and other directions, respectively. However, the recent observations of the Crab Nebula in its OFF phase, did not show the reflection of the pulsar's X-rays. The lack of reflecting X-rays from the pulsar by the Crab Nebula in the OFF phase does not support the lighthouse model as expected. Recently, Zhang (2015) has developed a new physical model for pulsars as gravitational shielding and oscillating neutron stars. In this study, we will, based on this new model, investigate the pulsations of oscillating neutron stars. We will explore the dependence of pulsating power and frequency on the mass and initial state of neutron stars and compare results of our studies with measurements. Preliminary results obtained are consistent with observations, which give substance to the model of pulsars as oscillating neutron stars.

SI - 43 Michelle Lieu, Siena College, *Poling Study of Lead Zirconate Titanate*

The project studied the electric properties of lead zirconate titanate (PZT) films to investigate the poling behavior; the results are important for the use of thin films as actuators in microelectromechanical systems. Ferroelectric and piezoelectric characterization of the film before and after application of a dc electric field (poling) was done using a Double Beam Laser Interferometer (DBLI) and a Multiferroic analyzer. Electrodes were poled by applying an electric field at 150 oC. Results showed PZT samples with lower lead content can withstand greater poling electric fields and therefore exhibit better piezoelectric response. In samples of the same lead contentacceptor-doping (manganese) produced more imprint of the polarization after poling than donor-doping (niobium). However the acceptor-doped sample gave lower piezoelectric response. Further research can determine the optimal ratio of lead and dopant content."

SI - 44 Ava Ghadimi, City University of New York, *Searching for sources of astrophysical neutrinos: a multi-messenger approach with VERITAS*

In 2013, the IceCube collaboration reported the detection of several high energy muon neutrinos of astrophysical origin. The collaboration has also reported the detection of an all-sky flux of high-energy astrophysical neutrinos. Thus far, no point-sources have been detected by IceCube. Cosmic-ray interactions that are capable of producing high energy astrophysical neutrinos, should also produce gamma-rays. These gamma rays can be detected by observatories such as VERITAS (Very Energetic Radiation Imaging Telescope Array System). We present our results from follow-up VERITAS observations of 28 IceCube muon neutrino events with energies above 100 TeV. We did not detect gamma-ray excess at the location of these neutrino events but we have calculated the gamma-ray flux upper limits and will discuss how our results connect to the all-sky neutrino flux.

SI - 45 Grant Cates, Linfield College, *Investigating How Restricting Geometry Affects the Electronic Properties of ZnO Nanostructures p*

Understanding the electronic structure of mesoscopic systems is vital in order to functionalize low-dimensional nanostructures such as graphene. However, due to the length scales at play, restricting the geometry of a mesoscopic system changes its electronic structure. We investigate the effects of restricting the geometry of zinc oxide (ZnO) in its hexagonal wurtzite crystalline structure. More specifically, we investigate the conducting and insulating bands of bulk material, of one-dimensional nanowires and of zero-dimensional nanowires. ZnO is chosen for study because of its desirability for functionalizing graphene due to its known sensitivity to O2, NO2 and NH3Ñgases that might indicate organic processes. Using Quantum Espresso, we perform Density Functional Theory calculations to approximate the electronic structure for each nanostructure.

SI - 46 April Raab, Roanoke College, *VO2 Based Thermochromic Smart Windows*

We wanted to explore VO2 for its applications in thermochromic smart window films since it undergoes a metal to insulator transition (MIT) at ~68C1. Our goal was to lower the transition temperature (~25°C) via doping to increase its practicality, as well as add to the knowledge base in understanding the mechanism. We studied Europium, Dysprosium, and Tungsten as our dopants; VO2 film samples were synthesized using a thermal evaporator and chemical vapor deposition (CVD) in which VO2 powder in a tungsten boat and V2O5 powder in a quartz boat were vaporized at ~400C and ~800C onto FTO (fluorine doped tin oxide) coated glass and silicon substrates, respectively, while a three-electrode system was used to dope the samples. A UV-Vis-NIR Spectrophotometer was used to measure the transmittance of samples from 300-1650 nm at varying temperatures by way of a PID Controller setup. We successfully observed a decrease in resistance and transmittance of IR for VO2 as temperature was increased, and the 5% a. Tungsten doped VO2 lowered the MIT temperature to a more practical 33C. The other ions did not lower the MIT temperature.

SI - 47 Caylin VanHook, Louisiana Tech University, *Characterization of Semiconductor Materials for Surface Plasmon Polariton Diode*
Surface Plasmon Polaritons (SPPs), spatially confined electromagnetic modes propagating at metal-dielectric interfaces, offer the potential to build devices that have both the bandwidths of photonic devices and share the physical dimensions of nanoscale electronics. We present numerical modeling of the operation of an active electronically controlled plasmonic switching element for fully-functional plasmonic circuits, based on a highly doped p-n junction semiconductor SPP waveguide, referred to as a Surface Plasmon Polariton Diode (SPPD). We have introduced two figures of merit, one that defines the size range of SPPDs in comparison to conventional optical devices, and another that describes the localization properties and the dissipation losses of the SPPs. In addition, we have performed a comprehensive parametric study of the SPP properties at the interface of the doped semiconductor materials including Silicon (Si), Gallium Arsenide (GaAs) and Indium Arsenide (InAs). The study includes the SPPD's optimal operation range based on both applied voltage and doping concentrations. The analysis from the above study indicates that Indium Arsenide is the best semiconductor material for the SPPD, providing high optical confinement, reduced system size, and fast operation. We show that the InAs based SPPD operates at signal modulation up to -24 dB and switching rates that surpass 1THz, thereby providing a new path to bridge the gap between electronic and photonic devices.

SI - 48 Jared Powell, Eastern Michigan University, *Plasma Instability Chamber*
Plasma, the fourth and most abundant state of matter, consists of ionized gas and free electrons resulting in no net charge. The understanding of plasma has a broad range of applications, including but not limited to, space and astrophysics, atmospheric sciences, and industrial etching and cleaning. The goal of this research is to construct a vacuum system to conduct plasma experiments, primarily focusing on the radio communication problem that occurs with spacecraft reentering Earth's atmosphere. We will measure plasma instabilities to learn how plasma interacts with incoming radio signals and attempt to determine a technique to reduce or eliminate the signal attenuation that occurs.

SI - 49 Caleb Mosakowski, California State University, Sacramento, *What Comes After the Higgs?*
A search for an exotic particle in p-p collisions at a center of mass energy of 13 TeV decaying into two Higgs Bosons which decay further into a pair of b quarks and a pair of photons using the ATLAS detector at CERN is presented . The angular distributions between objects are analyzed for subsequent optimization using a multivariate algorithm (MVA). The goal of this analysis is to identify which combination of these angular distributions can maximize the separation between the signal and background. The results are then fed these into an MVA to find signal and background events in the data. A comparison between Monte Carlo simulation and data from was also performed.

SI - 50 Christian Gilbertson, Virginia Polytechnic Institute and State University, *A Study of the Gamma-Ray Burst Fundamental Plane*
A class of long gamma-ray bursts (GRBs) with a plateau phase in their X-ray afterglows obeys a three-dimensional (3D) relation (Dainotti et al. 2016), between the rest-frame time at the end of the plateau, Ta, its corresponding X-ray luminosity, La, and the peak luminosity in the prompt emission, Lpeak. We extended the original analysis with X-ray data from July 2014 to July 2016 achieving a total sample of 183 Swift GRBs with afterglow plateaus and known redshifts. We added the most recent GRBs to the previous 'gold sample' (now including 45 GRBs) and obtained a relation plane with intrinsic scatter compatible within one σ with the previous result. We compared several GRB categories, such as short with extended emission, X-ray Flashes, GRBs associated with SNe, long-duration GRBs, and the gold sample, composed only by GRBs with light curves with good data coverage and relatively flat plateaus and evaluated their relation planes. We found that they are not statistically different from the fundamental plane derived from the gold sample and that the fundamental plane still has the smallest scatter. We compared the jet opening angles tabulated in literature with the angles derived using the Eiso–Egamma relation of the method in Pescalli et al. (2015) and calculated the relation plane for a sample of long GRBs accounting for the different jet opening angles. We observed that this correction does not significantly reduce the scatter. In an extended analysis, we found that the fundamental plane is independent from several prompt and afterglow parameters.

SI - 51 Andrew Truman, University of West Florida, *Fabrication and Characterization of Langmuir(-Blodgett) Thin Films of Fatty Acids, Benzene Derivatives, and Their Salts*
This project analyzed the formation of monolayer (Langmuir) and multilayer (Langmuir-Blodgett, LB) thin films of zinc stearate and 4-(nonyloxy)benzoic acid (4NBA). The isotherm of surface pressure vs. area per molecule for each film helped identify the phases of the monolayer. A zinc sulfate subphase formed salts of the molecules and stabilized the fatty acid chains, allowing for easier multilayer deposition. A glass slide was made hydrophobic by treating with iron (III) stearate and was dipped into the monolayer several times to create multilayer LB films. These films were analyzed through x-ray diffraction before and after skeletonization. The layer spacing, tilt angle, and transfer ratio for each film were compared.

SI - 52 Lucas Beving, University of Northern Iowa, *Magnetic Properties of the Nanostructured Dichalcogenide Mn0.18TaS2*
The phase transition of nanostructured Mn-intercalated TaS2 was investigated using a Quantum Design Physical Properties Measurement System (PPMS). The concentration of manganese relative to tantalum was determined to be 18%. The phase transition(s) of the sample were explored using a variety of techniques: Curie-Weiss, Critical Scaling, Arrott-Noakes, and Kouvel-Fisher. All but the first method include the use of critical exponents defined using the spontaneous magnetization and susceptibility in zero applied field. The sample was found to undergo a transition from paramagnetism to an ordered state below 100o Kelvin. Two of the aforementioned methods were converted to computational methods. These same methods for determining the transition temperature and critical exponents may also indicate the existence of a second transition very close to the first. These results have been extracted using the theory of scaling.

SI - 53 Hannah Hamilton, Abilene Christian University, *A Matched-Filter Search for Binary Black Hole Mergers in Advanced LIGO's First Observing Run*
During its first observing run, from September 12, 2015 to January 19, 2016, Advanced LIGO made the first detections of binary black hole mergers. In this poster, we describe the PyCBC analysis, and the results of a search for binary black holes with total mass up to 100 solar masses. That search used matched filtering of general-relativistic models of gravitational wave signals from binary black hole systems, and identified two clear signals, GW150914 and GW151226, each with a significance greater than 5 sigma, as well as a third possible signal with lower significance.

SI - 54 Conner Dailey, University of Nevada, Reno, *Preliminary steps in detecting Dark Matter with the GPS Satellite Constellation*
The GPS.DM Observatory is dedicated to detecting Dark Matter (DM) with the GPS Satellite Constellation. The search is for Topological

Defect DM that is theorized to cause small changes in fundamental constants, such as the Fine Structure Constant, to which atomic clocks are very sensitive. Each GPS Satellite is equipped with an atomic clock that keeps track of its time relative to base station clocks on the ground. The bias between those clocks can change if the satellite clocks run faster or slower due to a DM interaction. Using this, it is possible to detect these defects passing through the Earth. There are 15 years of satellite data freely available to search though to find these events. Before this can be done, first a model for the orbit of all the satellites must be established in order to project their positions and velocities in time. Second, the velocity of the Earth relative to the defects needs to be established so that we know from which direction the events will likely occur. With these steps completed, we can make a reliable model of what a hypothetical event should look like, and search though the data using computer software to find these hypothetical events.

SI - 55 Sean Counihan, University of Alaska Fairbanks, *The Power Grid, Optimization of Complex Dynamical Systems*
The failures of complex infrastructures which have enormous human and economic costs poses the question: Are there ways to optimize these systems to reduce the risks of failure? A dynamic model of one such system, the power transmission grid, is used to investigate the risk from failure as a function of the size and structure of the system. Using the Arctic Region Supercomputing Center we can investigate methods to optimize the configuration for the power grid which will furthest reduce the number and severity of blackouts experienced by the system. Two of the important characteristics are the size and structure of the grid. We will examine various grid structures and sizes, focusing on the strength of the lines connecting regions, in order to develop a prescription for the optimal configuration for any grid size. Reducing the number and severity of blackouts, to its furthest point, can strengthen our infrastructure and benefit society both, but not limited to, industrially and economically.

SI - 56 Mariana Supersano, University of Nevada Reno, *Molecular Frame Photoelectron Angular Distributions for Core Ionization of Amononia (NH3)*
We present experimental and theoretical results for the angular dependence of photoelectrons ejected from the core orbitals of Ammonia (NH3). An analysis of the experimental data to find the three dimensional molecular frame photoelectron angular distributions are shown here along with theoretical calculations. The theoretical calculations agree with the preliminary experimental data and shows a propensity for the photoelectrons to be emitted in the direction of the hydrogen bond axis when the polarization of the incident X-ray beam is averaged. This result is in agreement with previous experiments done with CH4 and C2H2F2. Our measurements employed the COLTRIMS method and the calculations were performed with the Complex Kohn Variational method.

SI - 57 Sarah Steiger, Boston College, *Photoluminescence of a Bismuth-Halide Double Perovskite for Optoelectronic Applications*
The efficiency of solar cells containing lead halide perovskite absorbers RPbX3 (R=organic cation; X = Br- or I-) has increased dramatically in recent years, though the toxicity of lead remains a point of concern for long term use of these materials. This has motivated the search for a lead-free perovskite with similar optoelectronic properties. Recently, a bismuth-halide double perovskite Cs2AgBiBr6 with a long fundamental photoluminescence (PL) and carrier lifetime of ca. 660 nanoseconds, has been synthesized and is considered to be a candidate for a tandem solar cell, with an indirect bandgap of 1.95eV. Here, a novel experimental set up is explored which allows for excitation of the bismuth-halide double perovskite and simultaneous PL capture using a fiber based femtosecond laser. Single-crystal and powder PL decay curves were obtained which suggest inherently high defect tolerance for these hybrid perovskite materials. Additionally, preliminary pressure dependent photoluminescence measurements have been made on the bismuth-halide double perovskite suggesting pressure can further tune its optoelectronic properties. These promising results motivate further exploration of halide double perovskites for photovoltaic and other optoelectronic applications.

SI - 58 Twymun Safford, University of West Florida, *Analysis of Outgassing Properties of Candidate Materials for Use With the nEXO Experiment*
The experimental search for neutrinoless double beta decay ($0\nu\beta\beta$) is a test of the Majorana nature of neutrinos and the violation of lepton number. With some uncertainty, the rate of neutrinoless double beta decay is also proportional to the square of the effective Majorana neutrino mass. EXO-200 is an experiment designed to search for double beta decay of xenon-136 using a single-phase, liquid xenon detector. EXO-200 uses an active mass of 110 kilograms of liquid xenon-136 enriched to 80.6% in an ultra-low background time projection chamber capable of simultaneous detection of ionization and scintillation.

The University of Illinois at Urbana-Champaign collaborates with the EXO-200 experiment. During the summer at the University of Illinois at Urbana-Champaignresearch was conducted by utilizing a vacuum chamber in tandem with a vacuum pump to analyze the outgassing properties of various candidate materials in terms of electronegative impurities for use with the future nEXO experiment. Materials such as kapton flexible connection cables were used. In the future plans to construct a carbon nanotube-based adhesive will be executed to inexpensively simulate the behavior of parts used in the recirculation process of the liquid xenon."

SI - 59 April Smith, Cleveland State University, *Real-time monitoring of prostate radiation therapy with ultrasound*
The goal is to validate the Clarity ultrasound real-time monitoring system in external beam prostate and prostate bed cases in the field of medical physics. Clarity provides a motorized ultrasound transducer that attaches to the treatment couch. The transducer's position relative to the treatment isocenter is ascertained by infrared markers and cameras. This provides a real-time 3D image of the prostate or bladder neck that can be used for initial patient alignment and motion monitoring during treatment. At this stage, cone-beam CT imaging (CBCT) is still used, after Clarity, for confirming the alignment of the patient.

Initial analysis of three SBRT prostate and three prostate bed patients is presented. The pre-treatment shifts needed for the ultrasound image set up position to match the CBCT position averaged to 1.61 mm superior0.92 mm right and 0.92 mm posterior which shows the reliability of the system. The magnitude of the shifts of the prostate for each of the fractions are analyzed. Kaplan Meier Estimate curves were used to display the percentage of fractions compared to actual monitoring time that stayed within a 1 2 or 3 mm margin.

The institution of ultrasound as a real-time image guidance system for the prostate is beneficialproviding valuable information without concern to the patient due to non-ionizing radiation. Further research will explore the movement of the prostate throughout patient treatment in order to assess achievable margins per patient to maximize prostate radiation dose while minimizing dose to the organs at risk (bladder rectum, urethra,

SI - 60 Egla Ochoa-Madrid, Adelphi.edu, *Creating an Interactive Video Vignette on the Topic of Torque*
We are creating an Interactive Video Vignette (IVV) to teach torque through elements of dance. We aim to help students connect physics to real world settings and to enhance the education process by providing

them with a method of studying that encompasses different ways students learn and retain information. By using an example that would otherwise not be thought of as a physics lesson, we make the topic more relatable and therefore easier to learn. We will discuss lessons learned in the process of creating an IVV intended to teach torque to an audience that may be learning this concept for the first time.

SI - 61 Edwin Rivas, Saint Peter's University, *Gold Nanoparticle Generation with the Assistance of Atmospheric Pressure NonThermal Microplasmas*
Gold nanoparticles (AuNPs) were generated using atmospheric pressure, non-thermal plasma to formulate an aqueous electrolyte solution containing hydrogen tetrachloroaurate [HAuCl4] and trisodium citrate [Na3C6H5O7]. The atmospheric pressure, non-thermal plasma chemistry facilitated a rapid synthesis of the gold nanoparticles. For the first set of solution testing, the concentrations of the gold and citrate were changed. Of this, fifteen trials were conducted. Five trials then proceeded to look at other parameters such as current, voltage, plasma discharge mode, and distance. Optical properties of the gold nanoparticles were characterized by ultraviolet-near infrared [UV-NIR] spectroscopy. The results were then categorized by the respective concentrations and the maximum wavelength peak and absorbance. The various trials allowed us to determine that 34 mM of Na3C6H5O7 and 9.712 mM of HAuCl4 were the optimal concentrations for the generation of AuNPs. With a steady plasma discharge, a 1 mm distance from the electrode to the surface of the solution, and an exposure time of 3 minutes, the synthesized gold nanoparticles produced a 613.4 nm maxi-peak wavelength and a .940 absorbance. We hope to integrate ultrasonic cavitation into the experiment to observe if it can help facilitate the formation of the AuNPs, such as size and uniformity control.

SI - 62 Ke'La Kimble, Xavier University of Louisiana, *LiPON thin films grown by physical vapor deposition*
Lithium phosphorus oxynitride (LiPON) thin films have been deposited by a physical vapor deposition method. LiPON thin films were deposited on approximately 0.2 µm thick Au-coated ceramic substrates in a pure N2 plasma atmosphere at 9x10^-3 torr, a power of 70 W using a lithium phosphate (Li3PO4) target. LiPON growth thicknesses varied from 2 to 3 µm in a 24 hour deposition time. X-ray powder diffraction showed that the films were amorphous, and elemental dispersive x-ray spectroscopy revealed approximately 4 atomic %N in the films. The ionic conductivity of LiPON was measured by electrochemical impedance spectroscopy to be approximately 1.02 µS/cm, which is consistent with the literature value of this electrolyte. We plan to use these parameters to deposit LiPON onto a gel impregnated ceramic polymer as a sacrificial layer between the polymer and a Lithium anode to eliminate inter-facial resistance amongst the two components in a solid state Lithium battery cell.

SI - 63 Eric Vickers, Florida Polytechnic University, *Environmental Monitoring with Wireless Sensor Networks*
In a collaboration project with Skanska Construction, students at Florida Polytechnic University were given an opportunity to create a system that would monitor different conditions at construction sites close to areas actively serving patients. Our research brings together state-of-practice technologies in an efficient way to reduce the cost of environmental monitoring. We monitor differential pressure, vibration, noise, and particulates in the air. Our sensor node consists of a microcontroller that receives the data from the sensors, turns the data into packets, and transmits to a central receiving node with a radio communication device. The central receiving node parses, stores, and processes the data for visualization. We have completed and tested the proof of concept and our current efforts include field testing and calibration of the sensors.

SI - 64 Anthony Zummo, University of Pittsburgh, *Search for Bs → η η′ and Bs → π0 η′ in Belle Data*
We search for the decays Bs → η η′ and Bs → π0 η′ using 121.4 fb-1 of data collected at the Υ(5S) resonance with the Belle detector at the KEKB asymmetric-energy electron-positron collider. These decay modes are suppressed in the Standard Model of particle physics and proceed through b → u transitions, or b → s transitions, which are sensitive to new physics. The expected branching fractions in the Standard Model are 33.5 × 10-6 for Bs → η η′ and 0.12 × 10-6 for Bs → π0 η′. Neither decay mode has been observed yet. We use Monte Carlo simulation to optimize our selection criteria for signal events and a Neural Network to separate signal from background events in order to make an accurate measurement of these branching fractions.

SI - 65 Megan Cromis, Abilene Christian University, *Designing and Building of an External Cavity Diode Laser*
Abilene Christian University's atomic physics research laboratory has a goal of studying interactions between atoms excited to very high energy states known as Rydberg states. This work requires a custom built laser housing system optimized to provide long term stability and ease of use in order to take accurate data over long timeframes. Taking place at Abilene Christian University's Bennett Gymnasium, an undergraduate team under the advisement of Dr. Larry Isenhower designed and built a system based on a design from the Steck laboratory at the University of Oregon. Upon completion we will study the stability of the lasers as parameters such as temperature, vibration strength, and pressure are varied. This poster will cover the background of the experiment, the design process, building techniques, showcase the final product, and provide insight into the future use of the system.

SI - 66 Shawn Kirby, California State University of Long Beach/ Air Force Research Laboratory, *Effects of Surface Coatings on the Crystallization of Calcium Sulfate*
Deposits from hard water can be problematic as they can form scaling on boilers and cooling towers. Scaling can reduce thermal efficiency. Coatings can be used to prevent mineral fouling by changing the surface energy. Some deposits have inverse solubility; such as calcium sulfate. This means that as temperature rises, they become less soluble and can crystallize out of solution. Calcium sulfate is often found in hard water. Crystalization tests were done to determine how coatings such as various POSS (Polyhedral oligomeric silsesquioxane) compounds acted as nucleating surfaces for calcium sulfate. POSS compounds were tested in particular because they have very low surface energy. This would theoretically make nucleation difficult. Solutions of calcium sulfate were placed in microwave vials with different nucleating surfaces. The vials were sealed and heated to 95ûC. After cooling, tests were done to determine the amount of calcium sulfate that had come out of solution.

SI - 67 Anthony Asuega, California State University, Sacramento, *Measuring Pressure in Low Temperature Systems*
We are working to develop a new method of measuring pressure at low temperatures by using piezoelectric ceramics as low temperature pressure sensors. The sensors work by the piezoelectric effect, where changes in pressure deform the piezoelectric material which produces a voltage that we are able to measure. Eventually we hope to use this method in measuring pressure gradients in solid helium by embedding the sensors in the solid.

SI - 68 Austin Bradley, George Mason University, *Evaluating the Charged Particle Rejection Requirement for an Experiment to Measure the Branching Ratio of KL to pi0 nu nubar*
Measuring the rate at which the long-lived, neutral kaon decays into a neutral pion, neutrino, and anti-neutrino allows physicists an opportunity to test precise predictions made by the Standard

Model. Differences between theoretical predictions and experimental measurements may point to new physics, and could provide part of an explanation for the difference in amounts of matter and anti-matter in our universe. Not only does the Standard Model of particle physics predict a very low probability at approximately 3 KL to pi0 nu nubar decays in 100 billion KL decays, but many of the common decays leave false signals in the detector that look the same as the true signal. Charged decays have been studied to determine the required detection efficiency necessary to eliminate them. The conclusion of these studies is that a reduction by a factor of 1/(3x10^9) will be required to achieve the 10:1 signal to charged background ratio necessary for the experiment.

SI - 69 Samori Roberts, Morehouse College, *Improved oilfield GHG accounting using a global oilfield database*

The definition of oil is shifting in considerable ways. Conventional oil resources are declining as oil sands, heavy oils, and others emerge. Technological advances mean that these unconventional hydrocarbons are now viable resources. Meanwhile, scientific evidence is mounting that climate change is occurring. The oil sector is responsible for ~35% of global greenhouse gas (GHG) emissions, but the climate impacts of these new unconventional oils are not well understood.

As such, the Oil Climate Index (OCI) project has been an international effort to evaluate the total life-cycle environmental GHG emissions of different oil fields globally. Over the course of the first and second phases of the project 30 and 75 global oil fields have been investigated respectively. The 75 fields account for about 25% of global oil production. For the third phase of the project, it is aimed to expand the OCI to contain closing to 100% of global oil production; leading to the analysis of ~8000 fields. To accomplish this, the integration of the data into the computer science language SQL (Structured Query Language) was performed. The implementation of SQL allows users to process the data more efficiently than would be possible by using the previously established program (Microsoft Excel). Next in the computer science language of C#

SI - 70 Taylor Ferebee, Roanoke College, *Multiwalled Nanotube In Vitro Bundling of F-Actin*

While the study of the emergent properties of actin filament bundles has been investigated heavily, few investigations have focused on the bundling morphologies of actin filaments as a result of nanoparticle interaction. Evidence from previous investigations predict that the addition of rigid rod solutions, such as dispersed carbon nanotubes, does affect actin filaments but only a few studies report any induced bundling behaviors from these interactions. Herein, we report in vitro actin bundling morphologies do arise as a result of interactions between F-actin and multi-walled carbon nanotubes (MWNTs). To characterize these interactions, we devised a series of experiments that 1) acknowledged the interactions between the actin and nanotubes, 2) observed the mixing behaviors of the actin and nanotube solutions, and 3) identified bundle formation in aligned nanotube environments. We were able to simulate cellular conditions by dispersing multi-walled nanotubes into the biocompatible copolymer Pluronic F-127. We then carried out these experiments with rhodamine-phalloidin stained actin in order to utilize fluorescence microscopy. Together with the reports from other investigations, we believe that these properties point to a preferential binding energy between the MWNTs and actin monomers most likely do to the anisotropic nature of these materials. Furthermore, these findings suggest that the understanding of the interactions between these materials be studied for reasons including toxicity, and biological impact.

SI - 71 Niyousha Davachi, University of Texas At Arlington, *Standard and Non-Standard Lagrangians*

A concept of non-standard Lagrangians is introduced and general conditions for the existence of such Lagrangians are presented. The conditions are used to determine classes of ordinary differential equations that can be derived from non-standard Lagrangians. The obtained results are used to derive non-standard Lagrangians for several dynamical systems of physical interest.

SI - 72 Hazel Betz, Oregon State University, *Cosmic Ray Counts Using a Geiger Muller Tube Array*

The joint Linn Benton Community College/Oregon State University Space Exploration Team participated in NASA's RockSat-C program to design and build a small scientific rocket payload. The team's payload was flown in June of 2015 on a sounding rocket launched from Wallops Flight Facility in Virginia to an altitude of approximately 115 km.

The team's payload was designed to count cosmic rays and their derivatives in the upper atmosphere and near space. The project was chosen because cosmic rays are of particular interest in the modern world as they can interfere with data storage in electronics.

The payload's three basic components were a small hexagonal array of six Geiger-Mueller tubes (G-M tubes)a latching circuit and an Arduino to store data. The latching circuit was designed to differentiate between events involving multiple G-M tubes and events involving a single G-M tube. A multi-tube event was assumed to be a cosmic ray and a single tube event was assumed to be a lower energy derivative of a cosmic ray. The flight was a successrecording 1035 single tube events and 45 multi-tube events with an expected event peak at around 30 km. This was a 1450% increase in events compared to ground tests."

SI - 73 Sarah Coccia, Drexel University, *Cosmic Ray Induced Bit flipping Experiment (CRIBFLEX)*

CRIBFLEX is a novel approach to mid-altitude observational particle physics intended to correlate the phenomena of semiconductor bit-flipping with cosmic ray activity. Here a weather balloon carries a Geiger counter and DRAM memory to various altitudes; the data collected will contribute to the development of memory device protection. We present current progress toward initial flight and data acquisition. This work is supported by the Society of Physics Students with funding from a Chapter Research Award.

SI - 74 Gabriel Nowak, Oregon State University, *The Sidereal Time Variations of the Lorentz Force and the One-Way Speed of Light.*

The Continuous Electron Beam Accelerator Facility (CEBAF) at Jefferson Lab produces electrons that orbit through a stable magnetic system. The electron beam's momentum can be determined through the radius of the beam's orbit. This project compares the beam orbit's radius while travelling in a transverse magnetic field with theoretical predictions from special relativity; which predicts constancy of beam orbit radius as a function of earth's rotation. Time variations in the beam orbit's radius are found at the beginning and the end of a magnetic arc. These variations in the orbit correspond to variations in the beam's momentum. Beam position monitors (BPMs) provide the information needed to calculate the beam momentum. Multiple BPM's are included in the analysis and fitted using the method of least squares to decrease statistical uncertainty. Preliminary results from data collected in ARC #1 over a 24 hour period show that the relative momentum change was less than 10 –4; which corresponds to an upper limit in the relative one way speed of light of 10 –10. The results from this analysis will be used in an experiment to better determine the upper bound on the anisotropy of the one way speed of light. The current upper bound is on the level of 10-14 and we hope to achieve 10-16 using ARC #9 data.

SI - 75 Jennifer Soter, Drew University, *Assessment of temporal features of neural circuits in primary olfactory regions*

The general aim of research in our laboratory is to characterize features of odor-object representations in primary olfactory regions of the ventral telencephalon, particularly within the cortical and medial amygdaloid nuclei (CoA) and the olfactory tubercle (Tu) by analyzing neural circuity and measuring changes in neuron voltage output. Recent findings from our laboratory suggest that a large proportion of neurons in CoA and Tu show odor selective alterations in firing rate in response to volatile odors (Savage et al., 2015). The current work extends these findings to examine temporal features of neuronal spike trains by (1) comparing spike voltage timing to ongoing respiration to determine if there is a phase relationship and (2) using cross-correlation to determine the extent of coincident firing between simultaneously recorded cells. Custom code was generated using MATLAB to perform analysis on previously recorded voltage data. Collectively, these analyses will permit a better characterization of olfactory coding principles and the functional organization of primary olfactory areas of the brain.

SI - 76 Kathleen Hamilton, Howard Community College, *Enlightening Students about Galactic Dark Matter*

Dark matter pervades the universe. While it is invisible to us, we can detect its influence on matter we can see. To illuminate this concept, we have created an interactive javascript program illustrating predictions made by six different models for dark matter distributions in galaxies. Students are able to match the predicted data with actual experimental results, drawn from several astronomy papers discussing dark matter's impact on galactic rotation curves. Programming each new model requires integration of density equations with parameters determined by nonlinear curve-fitting using MATLAB scripts we developed. Using our javascript simulation, students can determine the most plausible dark matter models as well as the average percentage of dark matter lurking in galaxies, areas where the scientific community is still continuing to research. In that light, we strive to use the most up-to-date and accepted concepts: two of our dark matter models are the pseudo-isothermal halo and Navarro-Frenk-White, and we integrate out to each galaxy's virial radius. Currently, our simulation includes NGC3198, NGC2403, and our own Milky Way.

SI - 77 Christian Gunder, Cleveland State University, *"Correlating Wet-sample Electron Microscopy with Light Scattering Spectroscopy on the Example of Polymeric Microgels"*

Scanning electron microscopy and dynamic light scattering are employed to study the behavior of thermoresponsive polymer microgel systems, with a reversible shrinking-phase transition above 40.5¡ (the low critical solution temperature), under dynamic temperature conditions. In order to enable the direct imaging of the microgels in solution, a wet-sample electron microscopy methodology is developed, in which the sample is sealed behind a thin SiN window that isolates the liquid sample from the electron column vacuum. Thus the dynamics of individual microgel particles under changing temperature conditions can be imaged with the high spatial resolution afforded by scanning electron microscopy. Correlation of these measurements with the results from dynamic light scattering on microgel solutions provides unique insights into the complex behavior of these systems, which are relevant for applications in drug delivery and bio-sensing. Moreover, the development of the wet-sample electron imaging methods is relevant for other soft matter systems that are challenging to image using electron microscopy.

SI - 78 Pradip Kattel, Howard University, *Graphene Water Interaction in the presence of Defects*

Graphene, being anon-polar substance, is expected not to dissolve in water. But there has been several papers in literature which shows graphene is hydrophilic. In fact, there has been a debate in literature whether graphene is hydrophilic or hydrophobic. So, we did a density functional calculation to analyze the wettability of the graphene. We assumed that the presence of hydrocarbon defects might have changed the intrictic wetability of graphene and produced that strange result. And we showed that out assumption is correct.

SI - 79 John Pickren, Lamar University, *Analysis of atomic spectra in medicines and flare towers with flame spectroscopy*

In this experiment we identify the chemical composition of certain medicines and their impurities, as well as observe flare towers from refineries located near Lamar University in order to determine their pollutants. For this purpose, we analyze the atomic emission spectra of flames using an Ocean Optics RedTide USB650 spectrometer with an optical resolution of 0.6 nm and a PASCO Xplorer GLX device for quick data analysis. Detailed analysis is further done with DataStudio software. From these spectra we find the temperature of the flame source by using methods such as Doppler (pressure) broadening of emission lines and Boltzmann distribution of atoms. The accuracy of our spectral measurements is assessed from standard NIST spectral data, including Grotrian diagrams and transition probabilities. The weaker emission lines are identified as impurities. Medicines with different functions (i.e. Aleve and Sudafed) show similar light patterns. We want to gather information from different medicines and classify them based on their function and treatment of different ailments. Our optical measurements support results in experiments of chemical analysis. We have developed a procedure for taking the emission spectra of refinery flare towers from a distance using a telescope. Preliminary results collected in-house with a Celestron AstroMaster 70 telescope of light emitted by discharge tubes located at large distances have yielded to encouraging preliminary results. We acknowledge the financial support of the STAIRSTEP program and Office of Undergraduate Research.

SI - 80 Megan Holman, Ithaca College, *Communicating Scientific Research to Non-Specialists*

Public outreach to effectively communicate current scientific advances is an essential component of the scientific process. The challenge in making this information accessible is forming a clear, accurate, and concise version of the information from a variety of different sources, so that the information is understandable and compelling to non-specialists in the general public. We are preparing a magazine article about planetary system formation. This article will include background information about star formation and different theories and observations of planet formation to provide context. We will then discuss the latest research and theories describing how planetary systems may be forming in different areas of the universe. We demonstrate here the original professional-level scientific work alongside our public-level explanations and original graphics to demonstrate our editorial process.

SI - 81 Kathleen Oolman, University of Wyoming, *Plasmonic Enhancement of AlGaN/GaN Superlattice Intersubband Absorption in the Near Infrared*

The intersubband transitions of m-plane AlGaN/GaN superlattices can be studied by observing the absorbance of the superlattice in the near infrared spectrum. The absorbance can be enhanced by using plasmonic enhancement of light-matter interactions on the semiconductor surface. This absorption enhancement was studied by observing the effects of a various plasmonic surfacing, such as an interface made from graphite, graphene, thin solid gold film, and two patterned gold surfaces. The first patterned gold surface was made by placing a TEM foil of gold with a lattice of 2µm diameter holes with 2µm spacing on the sample. The second was made by depositing gold through the TEM foil. The final interface was a combination of the 2µm deposited gold disks surrounded with graphene. The samples were polished to a 45¡ multi-pass waveguide and absorption was measured at room temperature using a Fourier transform infrared spectrometer. The thin multi-layered graphene and thin gold layer resulted in a large absorption enhancement. The patterned gold surfacing had a smaller effect, but still showed significant absorption enhancement. Graphite had the least enhanced absorption, possibly due a rough surface and poor surface contact. The combination of deposited gold circles and graphene had the highest absorption, showing a possibility of plasmonic surface enhancement through multiple materials and patterned structures. The results show plasmonic surface-enhanced infrared absorption is possible for m-plane AlGaN/GaN superlattices using graphene and gold structured interfaces. There is a possibility to tune and enhance absorption using various patterns and combinations of graphene and gold.

SI - 82 Calvin Leung, Harvey Mudd College, *Generating Bell Test Measurement Settings with Cosmic Photons*

All tests of Bell's Inequality to date have relied on the assumption that measurement bases can be chosen randomly by the experimenter, free of hidden-variable influences. There remains the outstanding possibility that local hidden-variable events influenced the choice of measurement settings mere milliseconds before the Bell test was done. Our experimental work focuses on eliminating this possibility by using photons from cosmological sources to generate the measurement bases used in a Bell Test. The vast space-like separation of the astronomical sources would require hidden-variable influences to take place billions of years ago. We have designed, built, and modeled a "cosmic setting generator" that generates these measurement bases. We observe >100 photons per second, using the 40-inch telescope at Table Mountain Observatory the farthest of which were emitted when the universe was only a tenth as old as it is now.

SI - 83 Thomas Coleman, Norfolk State University, *Norfolk State University's Rapid Response Robotic Telescope*

Norfolk State University (NSU) has built a 60 cm, Ritchey-Chretien, Rapid Response Robotic Telescope (RRRT) that saw its first light in 2007. The RRRT is a central part of the astronomy education initiative at NSU for in-service K-12 teacher training and general public outreach through collaborations with local public school systems and local amateur groups. The RRRT is located at Fan Mountain Observatory, Covesvillle, VA. It is fully automatic and also remotely controllable through the internet. The RRRT research activities is centered on the observational study of compact stars (and their progenitors), and the early photometry and polarimetry of Gamma-ray Optical Afterglows (GRB-OA). This telescope is part of the Swift follow-up team. This is a low inertia telescope (fast slew), is dedicated to the study of fast transient phenomena observing programs. We have also developed a fast-photometer (with less than 1 ms time resolution) based on silicon photomultiplier (SiPM) technology to study fast variations on stellar objects. The study of GRB-OA provides a natural complement to NSU's current nuclear and high-energy astrophysics programs. Furthermore, a local amateur astronomer group has also been using the RRRT. This group (the Back Bay Amateur Astronomers) are an important segment of the RRRT users. The RRRT is also a central part of our public educational outreach projects. Our observational astronomy courses has been greatly enhanced with access to this telescope. We plan a close collaboration with the BBAA and local public school systems and two-year colleges to allow student's access to the RRRT.

SI - 84 Joseph Mammo, University of South Dakota, *Low-cost Cross-platform Data Manipulation and Visualization Platform*

For almost every nuclear or particle physics experiment, there exists an inherent need for the automatic controlling and monitoring of the conditions of the employed hardware components, such as high voltage supplies, temperature sensors, pressure gauges and triggering devices, etc. Such a system frees physicists from tedious tasks and reduces the change of human errors in long term operations. It is crucial in experiments searching for annual modulating dark matter signals deep underground, where yearly long stable operation is a must. We are developing such a system funded by an NSF grant (PHY-1506036), consisting of daemon programs running in computers collecting data and a web-based GUI visualizing those data in a meaningful way in monitors of various sizes. The server-client design makes it convenient to monitor and control hardware from multiple mobile devices. The daemon program is written in Python utilizing its powerful plotting libraries and its ability to call hardware driver functions written in other languages. The GUI is based on JavaScript and CSS Bootstrap to make meaningful display of data in mobile devices with various sizes possible. As a proof-of-concept, we present a complete system monitoring temperature sensors for Ge detectors developed in the radiation detector laboratory. Adding other hardware into the system is straight forward thanks to the modularized design of the Python daemon.

SI - 85 Haley Marez, California State University, Sacramento, *Working on the FTK with the ATLAS Experiment*

I worked with the ATLAS Experiment at CERN on the Fast Tracker (FTK) which is part of an upgrade to the detector's trigger system. I worked on the Associated Memory Board (AMB) for the trigger that is responsible for pattern recognition. I analyzed the output data and matched it to its corresponding source where it was processed in the board. This will be used by the group to debug and check data acquisition from the boards.

SI - 86 Ben Michaud, University of Wisconsin River Falls, *Calculating Heat Efficiency on Campus Using Infrared Imaging*

Using data collected with an infrared camera, a mean external temperature for any given building can be found and subsequently compared to that of other buildings or the building's own internal temperature. This data gives a statistical basis for determining the heat efficiency of a building.

SI - 87 Jase Nosal, California State Polytechnic University Of Pomona, *Stainless Steel Surface Modification Using Cold Plasma Treatment*

Past studies have demonstrated that increasing the surface energy of metal materials improves their resistance to surface biofilm growth. We investigate surface energy modification with radio frequency-generated cold atmospheric pressure plasma composed of helium and oxygen on various metal surfaces as a means of reducing biofilm growth on metal implants within the body. We treated stainless steel using a commercial Surfx shower head type plasma reactor to determine the dependence of surface energy on the direction of plasma flow (parallel versus orthogonal to the surface) and on exposure time. Water droplet contact angle was used as a measure of surface energy and plasma molecular spectra were measured with a spectrometer throughout treatment to monitor the concentrations of reactive oxygen species which are known to prevent bacterial growth. Once the treatment times required to reach maximum surface energy levels were determined for both orthogonal and parallel processes, different time intervals were allowed to elapse between treatment and surface energy measurement to determine how long the treatment remains effective before the energy begins to decrease. For the materials tested, we present comparisons of surface energy for different plasma flow directions and exposure times, and discuss the post-treatment longevity of the elevated surface energies.

SI - 88 Jared Canright, New Mexico Institute of Mining and Technology, *Luminosity Curve Calculations and Applications in Radiation Hydrodynamics Codes*

An algorithm is described by which calculations of the escaping luminosity from a laser-ionized plasma, supernova, atmospheric blast, or similar scenario may be performed using LANL's OPLIB database. This algorithm exists in the SPECTRUM code for computing supernova light curves; jaytrace, a robust, lightweight toolkit suitable for plasma experiments, atmospheric blast simulations, and similar scenarios is described herein. LANL's radiation hydrodynamics code xRAGE is often used for stellar and atmospheric blast simulations, wherein observed spectra are of paramount importance; due to the often exponential dependence of opacity on temperature and density, small numerical artifacts can significantly alter the observed spectra. jaytrace is used to determine the effects of numerical artifacts in the code, notably shock front dispersion, and inform methods by which to correct them. Further examples are examined in the area of laser-induced high-energy-density plasmas.

SI - 89 Mitchell Ahlswede, University of Wisconsin River Falls, *Finding the Response Function of Neutron Monitors Through FLUKA Simulation*
Cosmic rays are high energy atomic particles traveling nearly the speed of light through space. When these cosmic rays interact with the earth's atmosphere, they start a chain reaction producing secondary particles that can reach the earth's surface. Some of those secondary particles, such as neutrons, are detected by neutron monitors placed around the globe. These monitors study space weather and changes in the earth's magnetosphere, which affects the rate at which particles are detected by neutron monitors. UW-River Falls maintains neutron monitors at the South Pole, McMurdo Station, and on campus. To better understand the data from neutron monitors, Monte Carlo simulations are done. A response function, which characterizes the rates of particles detected, can be used to compare different configurations of neutron monitors. Simulations of different types of neutron monitors with the same incident flux of cosmic rays and atmospheric conditions are used to investigate the response functions. We determined the response function of five different types of neutron monitors, first without the building or other surroundings. We then extended the simulations to explore the effects the physical environment has on the count rates of twelve neutron monitors tubes at the Amundsen-Scott Station at the South Pole. Results of the simulated response functions of five types of neutron monitors tubes along with the preliminary results of environmental effects on twelve neutron monitors at the South Pole will be shown.

SI - 90 Amber Haag, Virginia Military Institute, *Variable Polarization of HD 198478, HD 183143, HD 187929, and HD 197770*
We present the current results on an ongoing studying of the V band variability of 3 polarized standard stars (HD 187929, HD 183143, and HD 198478), and one non-standard polarized star, HD 197770. Our current results indicate that for the standard stars, HD 198478 has the largest variation in the degree of polarization, while HD 187929 has the least. The variation in position angle is largest for HD 198478 and least for HD 183143. For the non-standard star our results currently show that variation in the degree of polarization and position angle is significantly less than the standard stars. The results of statistical test will be presented that show HD 197770 is more stable than the standards over the same time period.

SI - 91 Erik D. Kvenlog, Virginia Military Institute, *The Quantum Eraser Experiment: Enhancing your Knowledge of Quantum Mechanics*
Using the Thorlabs Mach-Zehnder interferometer, we demonstrate how students can enhance their understanding of basic quantum properties and the link between optical physics and quantum mechanics. The act of quantum erasing uses polarization to demonstrate the interaction of two beams of light originating from the same optical path. As observers of the interferometer apparatus we can apply quantum concepts to study the effect that the polarization has on the resulting existence of interference patterns. The quantum eraser experiment is a tool for students to unify and supplement information gained from course material that is not necessary covered in introductory quantum mechanics, modern physics, optics, or general physics. By assembling the experiment from the ground up the students gain experience in formal experimentation and procedures and provide others with information on an intriguing topic in the realm of quantum mechanics.

SI - 92 Kishor Subedi, Howard University, *Exoplanets and Chance of Finding Life Beyond Earth*
An extrasolar planet or exoplanet is one that orbits around a star other than our Sun. Exoplanets can be smaller than the Earth or larger than Jupiter. If an exoplanet orbits very close to its starthen its surface temperature will be extremely hot. An Earth-like planet that orbits its star at the right distance will be able to host liquid water on its surface and afford the chance to support life. One way to discover an exoplanet is to measure carefully the brightness of a star over a long period of time and determine how its brightness decreases as the exoplanet passes in front of it. Such a transit method is especially good for M dwarf stars which are smaller than our Sun. Similar size exoplanets will be able to block a larger portion of the light from a smaller M dwarf star than bigger stars. As a result exoplanets orbiting M dwarf stars will be cooler and at the right temperature to support life. When such Earth-like planets pass in front of its star, a portion of the star's light passes through the planet's atmosphere and can be detected by a telescope. Such transmission spectroscopy measurements shed light on the molecular composition of the exoplanet's atmosphere. Three, Earth-like planets close to us - about 40 light years away - have recently been discovered in the constellation Aquarius by the Kepler Space Telescope (reported in May 2016) and offer one of the best chances of finding life beyond Earth!"

SI - 93 Bryant Ward, Utah State University, *Reestablishing Observations throughout the Mesosphere*
In the last few years, the Rayleigh-scatter lidar at the Atmospheric Lidar Observatory at Utah State University (ALO-USU; 41.74¡ N, 111.81¡ W) has been upgraded to extend observations from 70 km up to 115 km. This project describes a student project to build and use a complementary Rayleigh-scatter lidar to go from 40 to 90 km, from the upper stratosphere to the upper mesosphere. At the upper end, this new lidar overlaps with the high-altitude lidar. This was done in a period of just over two months. This lidar shares the same lasers, but introduces a 44-cm mirror and a new telescope for the lower altitude observations. The rest of the detector chain is modelled after the one used in the larger lidar. This small lidar will provide a ground-based way of remote sensing the upper stratosphere and mesosphere. Combined with the existing larger lidar, the entire system, covering 40 to 115 km, will provide continuous observations well up into the lower thermosphere. This combined system gives the greatest coverage of any Rayleigh lidar in the world.

SI - 94 Naomi Haddock, Howard University, *Symmetries in the Degeneracy of RNA*
When studying the genetic code for translating from RNA to amino acids, we can observe symmetry in the degeneracy. DNA being degenerate means that there are amino acids that can be "coded for" with more than one codon. There are 64 possible codons (a three "letter" code that corresponds to an amino acid) but only 20 amino acids and a stop command. In some cases, the third position in the codon will not affect the amino acid it will code for. For instance: CUU, CUC, CUA, and CUG all will code for Leucine. I will refer to this couplet as completely degenerate. In most other cases, the third position is needed in order to translate to an amino acid but can be approached in terms of whether it is a purine (A, G) or a pyrimidine (U, C). These groups are not completely degenerate, but for the most part partially degenerate.

We may separate these groups into 16 couplets. Half of these couplets are found to be completely degeneratewhile the other half are a combination of partially degenerate by the third position being a purine or a pyrimidine and those that fall into a category of "other". Separating the couplets into two groups we see symmetries and patterns regarding how deterministic a position in the codon or whether a purine or pyrimidine is there. I am working to find an explanation as to why we function this way on a very basic level in terms of physics."

SI - 95 Kyle Lueckfeld, University of Wisconsin - River Falls, *Monte Carlo Simulations of Neutron Monitors at the University of Wisconsin - River Falls*
We report on FLUKA simulations of the two neutron monitors at the University of Wisconsin-River Falls (UWRF). A neutron monitor is a detector based on the ground that is used to measure the number of high-energy particles, cosmic rays, that strike the Earth's atmosphere. Cosmic rays are composed mainly of high-energy protons and atomic nuclei. Cosmic rays usually originate from outside our solar system, from events including a supernovae and a gamma-ray burst. The count rate of particles seen by a neutron monitor is affected by modulations in the Earth's magnetic field caused by solar activity. Hence neutron monitors are use to observe space weather. A standard neutron monitor consists of four main cylindrically layered components: a polyethylene reflector, a lead producer, a moderator, and a proportional counter. A moderated, or bare neutron detector, consists of only the polyethylene moderator and proportional counter with no reflector or producer. It is more sensitive to its environment and therefore far more susceptible to background noise than a standard neutron monitor. A description of the two UWRF monitors and the results of simulations, including efficiency and count rates are presented, and plans for future work are discussed.

SI - 96 David Calvert, North Carolina State University, *Particle Analysis of the T2K Experiment and Error Analysis of Geant4 Models*
Geant4, a C++ based simulation program, is often used in conjunction with real data to extrapolate the energy or momentum of incoming particles in the Tokai to Komioka experiment. This experiment explores the behavior of neutrinos and how distance effects their ability to change flavors. It is essential to have physical accuracy within these simulations due to the frequency of their usage in research. In additionthis allows for more theoretical ideas to be explored without wasting the time or effort only to come up with meaningless data. Thusthe accuracy of these simulation models is of utmost importance in particle physics. In this poster the validity of different versions and different physical models in the Geant4 software are exploredand methods for their corrections are proposed. For some models corrections are put into place and the data is compared to that of the real world T2K data."

SI - 97 Samyukta Krishnamurthy, University of Mississippi, *The Effect of the Generalized Faraday Effect on Propagation of Polarization in the iTOP*
The objective of this experiment is to measure and analyze the Verdet's constant for Corning 7980, a previously uncharacterized fused quartz glass that is to be used at the Belle II experiment in Tskuba, Japan.

The Faraday effect is a magneto-optical phenomenon that describes the rotation of the plane of polarization of lightwithin a media in the presence of an external magnetic field. The experiment helps quantify this rotation with respect to the wavelength and the magnetic field.

Data collected through this experiment depicts a linear relation between angle of rotation and the magnetic field. A linear relationship is also established between the Verdet's constant and $-\lambda\, dn/d\lambda$ where λ is the wavelength and n is the index of refraction for the glass rod."

SI - 98 Keziah Sheldon, Drexel University, *Emission Line Correlations as Diagnostics of Quasar Winds*
We investigate correlations between UV and optical emission line properties for a sample of z~0.5 SDSS (Sloan Digital Sky Survey) quasars that have been observed by HST. The sample is designed to be comparable in luminosity to the existing "reverberation mapping (RM)" sample, but less biased in terms of their "eigenvector 1" properties. We seek to understand what the constraints of accretion disk winds are. Further, we hope to identify a local sample of wind-dominated quasars that are comparable to the RM sample that can be used to establish better black hole mass scaling relations for wind-dominated quasars at high redshift.

SI - 99 Amir Raz, University of Alaska, Fairbanks, *Tsunami Wave Run-up in Piecewise Sloping U-shaped Bays*
We present an analytical study of propagation and runup of long wave in piecewise sloping, U-shaped bays using a one-dimensional nonlinear shallow-water theory with cross-section averaging shallow water equations. The nonlinear equations are transformed to a linear equation by utilizing the generalized Carrier-Greenspan transform. This equation is solved using the propagation of the linear wave as the boundary condition at the toe of the last sloping segment. Our primary result is an analytical runup law for narrow channels and breaking criteria for monochromatic and solitary waves. To verify our findings, we conducted three numerical experiments, comparing our analytical solution to FUNWAVE, an experimentally verified numerical solver for the 2-D shallow water wave equations. Future applications of our work could potentially benefit fast tsunami forecasting for coastal communities.

SI - 100 Jessica Sullivan, North Carolina State University, *Modeling Kepler's Supernova Remnant with VH-1*
Thermonuclear supernovae, exploding white dwarf stars, produce most of the iron in the Universe and play other essential roles as well. The most recent such supernova seen in our galaxy is Kepler's supernova from 1604. Its remains are observable today with radio and X-ray telescopes and may hold clues to the nature of this type of stellar explosion. We present a potential 3D model for the evolution and structure of Kepler's supernova remnant using time-dependent hydrodynamic simulations. The progenitor system of Kepler appeared to emit an anisotropic wind of circumstellar material (CSM); as the system moved, the wind swept up surrounding interstellar material (ISM) into a bowshock. The subsequent supernova sent a blast wave into that bowshock. Separate versions of the code were developed to model the supernova blast wave and the formation of the bowshock. The results of these two simulations were merged and evolved together to create the complete model. By manipulating conditions such as the density contrast between the poles of the bowshock, the asymmetry of the circumstellar medium, and the angle between that asymmetry and the flow of the ISM, we were able to produce models that contained regions similar to those we expect are present in Kepler and further refinement of the parameters and analysis of the model will allow us to improve our understanding of the progenitor system that gave rise to Kepler.

SI - 101 Adam Workman, California State University, San Bernardino, *Effect of Thermal Annealing on the Organic Ferroelectric Vinylidene Fluoride*
Vinylidene Fluoride (VDF) has properties that are well-suited for organic electronic applications. Thermal annealing is performed on thin films of VDF in an effort to improve the film quality. VDF thin films are deposited onto Si wafer substrates using a custom built evaporator/sputtering deposition system. The Si/VDF samples are thermally annealed with a variety of annealing parameters, following a trapezoidal temperature versus time profile. Atomic Force Microscopy (AFM) measurements are used to determine the topographical features of the VDF thin films. X-Ray Diffraction (XRD) is used to determine the phase, orientation, and crystallinity of the VDF thin films as a function of annealing parameters. An increase in both Root Mean Square (RMS) roughness and the maximum peak-to-valley distance (Δz) is observed for samples that suffered damage during annealing, e.g. melting and/or sublimation. These observations are used to find upper limits of annealing temperature and annealing time. XRD measurements indicate: improved VDF thin film crystallinity, upon annealing, a shift in crystalline orientation, and that, prior to annealing, the VDF thin films were predominantly in the β-phase (020) orientation: a peak location (2θ) near 23.8°. After annealing, the peak shift indicates the presence of VDF in

the β-phase (110) orientation: a 2θ near 24.4°; the polarization is canted 30° away from the sample normal. Final analysis indicates that annealing improves the crystallinity of the film without compromising topography.

SI - 102 Natasha Collova, Siena College, *Investigating Gas-stripping in Abell 1367 using Halpha imaging*
Local group and cluster galaxies like Abell 1367 are notorious for having lower average gas content resulting in lower star-formation rates than those that live in less dense environments. Through data reduction and the analysis of Halpha images taken at the WIYN 0.9 m telescope at Kitt Peak National Observatory (KPNO), we were able to target star forming regions in specific galaxies. Our goal was to use the Halpha filter as an indication of these star forming regions that would possibly support the claim that theories such as RAM Pressure stripping, strangulation, or tidal interactions were taking part in stripping out the ionized Hydrogen gas. This ionized Hydrogen filter is a narrow-band imaging filter that is centered on the Halpha recombination line of Hydrogen. By obtaining continuum-subtracted images of individual galaxy cutouts, we compare environmental mechanisms to morphological effects. The process of the data reduction of HDI images and the qualitative results from Abell 1367 will be presented.

SI - 103 Dieff Vital, Florida Polytechnic University, *Phosphatic Clay-Diatom Mixture: Potential Material for Supercapacitor*
Recent research reported that a large area of land in Florida is covered with poor quality phosphatic clay, more concentrated in Polk County, and with no current use in agriculture. In our previous study, we have shown that the addition of a diatom species, Aulacoseira, appeared to enhance the capacitive property of the phosphatic clay. Synedra and Navicula are diatom species commonly found in the freshwater environments of Florida. These diatoms are particularly known for their transparent porous cell walls made of silica. This study explores on enhancing the capacitance of phosphatic clay when it is mixed with Synedra and Navicula as a potential material for supercapacitor. Phosphatic clay obtained from Polk County was blended with the diatoms Synedra and Navicula, combined at a 96:4 ratio by weight, and oven-dried at 210¡C. The dried sample was ground and pelletized at 8000 psi. Two replicates were obtained and coated with silver paint. Two leads were attached on the sides of the pellets using a conductive epoxy resin, and electrical testing was performed using a Keysight U1733C Handheld LCR meter. Results showed that at 100 Hz, pellets of clay and clay mixed with Synedra and Navicula had average capacitances of 28.35nF and 35.54nF, respectively. This indicates that the addition of various diatom species appears to enhance the capacitive property of phosphatic clay at varying levels.

SI - 104 Prakash Regmi, Howard University, *Theoritical Study of Adsorption of Nitrogen Dioxide on Graphene*
Nitrogen Dioxide is an air pollutant which has harmful effects on soil, plants, animals and humans. Thus, environmental monitoring of Nitrogen Dioxide is very important. Graphene, a 2-D layer of carbon, has high adsorption properties and can be used to make gas sensors. So, we using Molecular Dynamics, studied the rate of adsorption of Nitrogen Dioxide on Graphene-based materials.

SI - 105 Yekaterina Gilbo, University of Virginia, *A Geant4-based Simulation to Evaluate the Feasibility of Using Nuclear Resonance Fluorescence (NRF) in Determining Atomic Compos*
Customarily applied in homeland security for identifying concealed explosives and chemical weapons, NRF (Nuclear Resonance Fluorescence) may have high potential in determining atomic compositions of body tissue. High energy photons incident on a target excite the target nuclei causing characteristic re-emission of resonance photons. As the nuclei of each isotope have well-defined excitation energies, NRF uniquely indicates the isotopic content of the target. NRF radiation corresponding to nuclear isotopes present in the human body is emitted during radiotherapy based on Bremsstrahlung photons generated in a linear electron accelerator. We have developed a Geant4 simulation in order to help assess NRF capabilities in detecting, mapping, and characterizing tumors. We have imported a digital phantom into the simulation using anatomical data linked to known chemical compositions of various tissues. Work is ongoing to implement the University of Virginia's cancer center treatment setup and patient geometry, and to collect and analyze the simulation's physics quantities to evaluate the potential of NRF for medical imaging applications. Preliminary results will be presented.

SI - 106 Lisa Maszkiewicz, University of Maryland, College Park, *Examining the Value of Using Biology Examples to Teach Physics*
This class (Physics I&II for Life Science Majors) was created to help bridge the gap between physics and biology. This semester I worked on recitations each week with the students and all of them featured biology problems that could be solved by physics. The biology problems should make the students feel more comfortable and give them background information on the issue at hand. But, what if the biology is creating more problems than it is solving? We discussed several instances where the biology was incorrect in recitation, or it did not coincide with the physics that was trying to be taught.

SI - 107 Kevin Francis, University of West Florida, *New Materials using Cluster Expansion*
The lowest energy of a structure, also called the ground state can say a lot about a materials properties. Certain methods are used to try and find these stable ground states and determine their properties. UNiversal CLuster Expansion (UNCLE) trains a model and then predicts the energies for a range of compositions. UNCLE is primarily used for binary systems but with the right parameters it can be used on ternary and even larger alloys. The two ternary systems studied were Aluminium Copper Nickel (AlCuNi) and Aluminium Nickel Titanium (AlNiTi). These systems are both potential superalloys. These are alloys that can withstand extreme temperature and have use in aeronautics. Specifically in the use of turbines in engines. Both systems had 500 structures that were used to train a model and predict possible ground state structures for each system. The compositions with the lowest calculated energy were then used as a comparison set. The known energy for these compositions was found and then compared to what the model predicted. Doing so showed that copper rich compositions tended to be more accurate in AlCuNi nickel and aluminium rich compositions. The lowest energy for each composition is a list of possible stable ground states. This list will hopefully lead to new materials that have desirable properties.

SI - 108 Raul Rodriguez, St. Mary's University, *Modeling Zinc Whisker Formation: A Monte Carlo Simulation*
Metal whiskers are hair-like structures that grow from metal surfaces that can cause electrical failure in machinery such as satellites, aircraft, medical devices, and weaponry. Because an exact method as to how these metal whiskers grow has remained elusive, our lab focused on investigating the theory of where these whiskers are formed via electric fields present on the surface of said metals. To prove this, we created a Monte Carlo simulation which was used to model the irradiation of the metal samples under Ir-194. This model would provide an energy distribution of pulses created by the radiation, and would therefore provide a dose line profile that, once compared to irradiated samples, could ultimately be used to predict where on a metallic surface metal whiskers can form.

SI - 109 Brady Bermingham, Roberts Wesleyan College, *Temperature Regulation of a College Dormitory*
Aging dormitories built on college campuses during the years 1920 to 2000 often exhibit a lack of adequate ventilation and temperature

regulation. This can be prohibitively costly to remedy, given construction methods used at the time. The Miner Hall Dormitory at Roberts Wesleyan College is one such building. A major problem with the building is the high temperatures the rooms reach during the warm summer months and the high cost of heating the same building during the cold winters. In addition, physical discomfort can distract students from their studies and prevent them from doing their best work. Through this research we hope to determine methods to improve temperature regulation while minimizing energy consumption, cost and disruption to those living in the affected spaces. Research will include data from building plans, images from Google Earth and AutoCAD tracking the sun's rays, surveys from current residents and data from scientific experiments set up to measure the air flow and heat transfer throughout the building.

SI - 110 Khensu-Ra Love El, Morehouse College, *Superconducting Cavity: Wield Test and Structural Test*
A uniquely designed Superconducting Radiofrequency (SRF) cavity will be used to study surface resistance as a function of frequency, surface magnetic field, and different cavity processes. In minimizing surface resistance, the Quality (Q) factor, and energy efficiency increases. The accumulation of test results and recent findings urge us to better understand the surface resistance of superconductors. As a result, the focus of this study is to advance the limited knowledge on surface resistance as a function of frequency, magnetic field strength, and different processes to find a better-fitting equation. The procedure of this study includes designing, fabricating, and testing a cavity suitable for this study. The current focus in the project is the fabrication which includes verifying the unique weld, determining the structural strength of the cavity's shell, and confirming the functionality of the cavity's variable input coupler. Ultimately, the data could possibly assist in the creation of better cavities by improving their Q factor which would also lower the cost of running any experiments dealing with SRF conductors.

SI - 111 Eleanor Hook, Rhodes College, *Examining Ultraluminous Infrared Galaxies with Integral Field Spectroscopy*
Integral Field Spectroscopy is an astronomical technique that allows for the collection of individual spectra across a field of view; effectively, this means that extended objects need not be treated as point sources when examined using spectroscopy. This research focuses on Ultraluminous Infrared Galaxies (ULIRGs), a class of galaxies undergoing a collision with another galaxy, using data collected from the VIMOS instrument on ESO's Very Large Telescope. These galaxies are of interest because they are common at high redshift (that is, early in the universe's history) and are typically characterized by high star formation and black hole accretion rates. ULIRGs produce high-energy outflows from the energy in star death (supernovae) and black holes. To study these outflows, it is necessary to use data reduction software to eliminate artifacts in the data produced by the atmosphere, telescope, and instrument; this project concentrates on the reduction techniques required to prepare this data for further analysis.

SI - 112 Justin Johnson, Morehouse College, *Towards creating a metamaterial based tunable perfect absorber*
In 1999, John Pendry proposed split ring resonators (SRRs) as a way to achieve a high-frequency magnetic response from a non-magnetic material. SRRs are sub-wavelength resonators (essentially artificial "atoms") made of simple metals such as gold. Arrays of SRRs, termed metamaterials, have caught the interest of physicists, engineers, and materials scientists from around the world since new electromagnetically responsive materials can be designed by simply determining the geometry of the SRRs. Metamaterials have resulted in the demonstration of novel phenomena such as invisibility cloaking, negative refractive index, and near perfect absorption. In this study, we focus on the design of an array of gold SRRs integrated with a vanadium dioxide (VO2) thin film to create a tunable "perfect absorber". VO2 is insulating at room temperature and exhibits a phase transition to a metallic phase at ~340K. As such, at room temperature, our metamaterial would be highly reflecting, transitioning to a highly absorptive state above 340K. Our design approach utilizes full-wave electromagnetic wave simulations, with the goal of designing a perfect absorber that operates in the far-infrared region of the electromagnetic spectrum. The feasibility of our design will be discussed and will include the presentation of preliminary measurements on simpler (all gold or copper) perfect absorbers using terahertz time-domain spectroscopy.

SI - 113 Shoji Hishida, California State University, Fresno, *Analysis of Thermal Properties of Pr1-xNdxOs4Sb12 in the Range 10 - 300 K*
The compounds PrOs4Sb12 and NdOs4Sb12 have attracted interest due to their exotic properties at low temperature. The Neodymium compound shows ferromagnetic behavior, while the Praseodymium compound exhibits unconventional heavy-fermion superconductivity. The series of doped compounds Pr1-xNdxOs4Sb12 is being studied in order to understand the interaction between the unconventional superconducting and ferromagnetic effects. It has been shown that for particular concentrations of Nd and Pr, the phenomena of ferromagnetism and superconductivity are displayed simultaneously at low temperatures. In order to understand this system, it is necessary to characterize the normal-state behavior. The molar specific heat of Pr1-xNdxOs4Sb12 was measured in the range of 10-300 K, using the method of finite heat pulse relaxation calorimetry. Thermodynamic parameters of the sample are extracted from the molar specific heat data, including the Debye Temperature, Einstein Temperature, and electronic specific heat coefficient. These provide information about the lattice softening, rattling effect, and electron correlation, respectively. The evolution of these properties with respect to the Nd concentration, x, can then be determined.

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SI - 114 Denver Strong, William Jewell College, *Introductory Analysis of Ferrofluid Phenomenon*
Ferrofluids are systems composed of nanometer-sized magnetic particles suspended within a carrier fluid that allows the fluid to demonstrate magnetic properties when exposed to an external magnetic field. This past summer, a new project was begun in our department to study shaping of ferrofluids using various configurations of permanent magnets. We also measured the coefficient of static friction with two aluminum blocks with a ferrofluid lubrication. Lastly, to determine ferrofluid flow with a constriction, we stuffed a capillary and observed the flow of the fluid with a field.

Much of the data we collected was related to the magnetic field strength the fluid was exposed to. With regard to shaping the fluid samplesmuch was done with permanent magnets where we have created spike-less hills rings filaments and a bow tie. When we used electromagnets, creating multi-pole domains, merely by reorienting the poles. Friction experiments have also resulted in changes in the coefficient of static friction from approximately .59 to .38. During constricted flow controlling the friction of a system

SI - 115 Laura Goodman, North Carolina State University, *Measuring Stress Caused by Lasers on Quartz Crystal Microbalance Sensors*
The frequency response of an AT cut Quartz Crystal Microbalance (QCM) to laser irradiation has been increasingly studied in recent yearsas the combination of photons with materials on a QCM's electrodes enables fundamental studies of topics that span biophysics

to photovoltaics. In order for such studies to advancehowever the impact of heating effects associated with laser irradiation of the QCM must be accounted for. Prior studies reached qualitative conclusions that laser irradiation induces stress QCM's arising from non-uniform thermal expansionbut did not quantitatively measure the degree of stress. Secondary effects such as surface film desorption and/or changes in temperature were also reported to be present. We report here a study of the frequency response of AT and BT cut QCM's to laser irradiation. AT and BT cut QCM's have similar response to mass adsorptionbut opposite frequency response to stress levels allowing the stress levels induced by the laser light to be quantitatively measured when the results are compared. Studies were performed in both vacuum and airto control for the presence of adsorbed films. As expected system designs that minimize temperature gradients result in less of an effect.

SI - 116 Jesse Buffaloe, The University of Tennessee, Knoxville (UTK); Oak Ridge National Laboratory (ORNL), ***Using Discontinuous Galerkin Methods to Solve the Euler Equations in Curvilinear Coordinates***

The simulation of the core collapse supernova (CCSN) problem requires a hydrodynamics solver that can adequately handle both shocks and smooth ßows. Discontinuous Galerkin (DG) methods construct solutions that are linear combinations of basis functions (e.g. polynomials) on intervals of the computational domain and are well-suited to handle problems with both shocks and smooth ßows. Thus, a DG hydrodynamics solver may provide an improvement over current hydrodynamics solvers used within CCSN simulations. Our work extends the work of Zhang and Shu (2011; JCP, 230, 1238-1248) and consists of the development of a high-order DG solver for the Euler equations in generalized curvilinear coordinates. We provide a brief introduction to the CCSN problem, followed by an overview of DG methods and our use of them in solving the Euler equations in curvilinear coordinates. Results from a suite of 1D test problems are presented, and the suitability of DG methods in this context is discussed. Current work is focused on extending the solver to both handle multidimensional problems and ensure positivity of non-negative physical quantities.

SI - 117 Kyle Roberts, University of Washington, ***Calculating the radius of FRC's in MSNW's ELF Thruster***

MSNW LLC is hard at work revolutionizing the way interplanetary travel is done. A special Electrodeless Lorentz Force (ELF) thruster that uses Argon or Xenon gas, creates a plasma, and forms an FRC. The FRC is fired at about 25km/sec. Using standard techniques for interplanetary travel, a mission to mars would take at least 7 months, but the ELF thruster would shorten that travel time down to 2 months. This poster talks about methods used for calculating the radius of this FRC and how these techniques can be refined.

SI - 118 Megan Anderson, William Jewell College, ***EPR Study of the xTe*yTeO2*(1-x-y)V2O5, x+y=4, x=0.025 to 0.25 System***

When tellurium, tellurium oxide, and vanadium are made into a glass, the tellurium and vanadium atoms reform into two oxidation states. The original state for vanadium is V5+, but V4+ ions form in the tellurium vanadate glass due to doping with tellurium. The V4+ state of vanadium has one open spot in the outer orbital which allows for electron hopping. The higher the concentration of tellurium in a sample, the more V4+ ions form in that sample. Therefore, it was hypothesized that the samples with higher concentrations of tellurium should be more conductive due to enhanced electron hopping. Results from colorimetry confirmed this hypothesis due to the fact that unpaired electron concentrations are observed to increase with larger concentration of V4+. We used electron paramagnetic resonance to observe first derivative resonance lines and determine the ratios of V4+ to total vanadium in each sample. Our data showed V4+/Vtotal percentages from 2 to 10 percent. The general trend is an increase from 0.025 Te to 0.1 Te, after which the measured concentration was relatively constant. Broadening of the lines above 0.05 Te indicated that certain populations of unpaired electrons may not be detected by EPR methods, in agreement with the fact that measured concentrations do not significantly increase beyond 0.185 Te. Resolved spectra for 0.025 Te allow an estimate of unpaired electron separations to be determined. Results indicate values of order 500 pm, which is characteristic of the lattice constants within the system.

SI - 119 Jose Luis Baranda, California State University Chico, ***A demonstration of constructive interference using an ultrasonic finder***

When a spring is uniformly stretched in the reflection region of a rangefinder, there are lengths of string stretch for which the spring coil spacing is an integer half-wavelength of the rangefinder's ultrasonic carrier wavelength. Reflections from successive coils then add constructively, creating an erroneous distance measurement which can be used to determine the wavelength of the ultrasonic signal.

SI - 120 Scott Cox, Virginia Military Institute, ***In Situ Characterization of Optically Transparent Polymer and Dye pH Sensing Films***

This research project characterizes in situ ionically self-assembled monolayers (ISAM) pH sensing films. These types of films have potential applications in the biomedical field and as optical pH sensors. The films are fabricated by alternate immersion of transparent substrates in aqueous solutions of poly(allylamine hydrochloride) and Direct Yellow 4. The absorption of the film changes when the pH of the surrounding medium changes. We describe the steps in creating the experimental set-up, the fabrication process of the optically transparent films, and the results of the pH dependent absorption measurements.

SI - 121 Jalal Butt, Central Connecticut State University, ***Amelioration of Thermally Induced Oscillations in Atmospheric Backscatter Lidar Data***

Light Detection and Ranging (Lidar) is an effective tool for studying the dynamic characteristics of the earth's atmosphere. Lidar involves the detection of laser light scattered from atmospheric molecules and particulates to map atmospheric characteristics over altitude and time. The Micro-Pulse Lidar System (MPL) is a single frequency elastic backscatter system that utilizes a single telescope for both laser transmission and backscattered signal collection. Temporal oscillations observed in a Micro-Pulse Lidar System's backscatter data were investigated and found to be a result of the MPL System's housing laboratory's thermal fluctuations. A model was developed based on the signal's dependence on temperature and altitude to ameliorate the effects of these thermal artifacts on backscattered signals. Results could be applied to address thermally induced oscillations found in other monostatic lidar and ceilometer systems.

SI - 122 Dylan Cromer, UNC Asheville, ***Modeling Surface-Enhanced Raman Spectroscopy via Computational Electrodynamics***

Silver nanoparticles, when used as a Raman spectroscopy substrate, give rise to an effect known as surface enhancement. Oscillations of the conduction electrons on the surface of the silver nanoparticles enhance nearby electric fields, including the light incident on and scattered from these particles. This enhancement can increase the intensity of the light by a factor of up to ten billion. The cause of this enhancement, and the techniques and applications which take advantage of it, are still subjects of ongoing research. In particular, there is a strong dependence of surface enhancement on particle size and radius of curvature. Prior research projects suggest that analytical approaches to modeling surface enhancement are limited to the simplest possible shapes and smallest numbers of particles, and cannot be extended to realistic situations. This research applies computational electrodynamics to model silver nanostructures created by ferroelectric lithography.

SI - 123 Michelle Sugimoto, Kalamazoo College, *Probing surface conductivity in ultra-thin ALD ZnO films*

Infrared spectroscopy has been used to understand the temperature-dependent electronic properties of ZnO films grown by atomic layer deposition (ALD). Existing resistivity measurements show a transition from semiconducting to metallic behavior. Temperature-dependent IR transmittance measurements track changes in conductivity through broadband lineshape evolution at low temperatures. These observations are interpreted as originating from a partial charge transfer from the O-terminated surface to the Zn-terminated surface. Addition of an insulting top-layer has been shown to decrease the temperature at which the sample changes from semiconducting to metallic behavior, as well as lower the free carrier response.

SI - 124 Tell Lott, Howard University, *Gamma Ray Detection with HAWC*

This past summer, I was working with Dr. Ignacio Taboada at Georgia Institute of Technology. The research was be dealing with analyzing Gamma Ray Bursts. Gamma Ray Bursts (or GRBs for short), are flashes of gamma rays that have been observed in distant galaxies. They are associated with large explosions which emit a lot of energy. They are the brightest electromagnetic events known to occur in the universe. These bursts are typically relatively short; some last for several hours, but many last for only a few milliseconds. These Gamma rays also give off secondary particles, which The High Altitude Water Cherenkov Observatory (HAWC) is equipped to detect. HAWC, an observatory located in Puebla, Mexico, consists of large tanks of water called Cherenkov detectors, of which it will eventually have more than 300 in number. Each of these tanks contains four photomultiplier tubes, highly sensitive detectors of light. It uses the difference in arrival times of the light at different tanks to measure the direction of the secondary particle, as well as its energy. Due to its extremely high sensitivity, the observatory also a prime detector of TeV Cosmic Rays. However, this ultimately serves as an undesirable background for the detection of gamma rays for the purpose of our research. Therefore, the task for this project is to analyze that data in its totality. The HAWC software supplies of a list of events that occur based on the Cherenkov detectors, and a handful of them are gamma rays. This observatory, detection technique that differs from the classical astronomical design of mirrors, lenses, and antennae, will further bolster the astrophysics community in its pursuit of scientific and technical knowledge. HAWC construction and operation is funded jointly by the U.S. National Science Foundation, the U.S. Department of Energy Office of High-Energy Physics, and Consejo Nacional de Ciencia y Tecnolog'a (CONACyT) in Mexico and the Laboratory Directed Research and Development (LDRD) program of Los Alamos National Laboratory.

SI - 125 Oliver Berroteran, The George Washington University, *Developing a Framework for Middle School Science Workshops.*

For the past two Springs, the George Washington University Society of Physics Students has conducted a series of science workshops for middle schoolers. In this presentation, we describe our efforts, successes, and failures, in the hopes of providing a framework for other SPS chapters to implement and expand on for their outreach efforts. Additionally, we describe how we are working to improve this framework. We present methods we have developed to assess the effectiveness of our framework, and to fine-tune it further as we conduct our outreach in the Spring.

SI - 126 Timothy McSorley, Drexel University, *Developing Star Camera Mount for BLAST-TNG Experiment*

The cosmology experiment, BLAST-TNG (Balloon Borne Large Aperture Sub-millimeter Telescope - The Next Generation), uses two highly sensitive "star cameras" to track the location of observation. The precision of the coordinates the camera produces are extremely vital for positioning the optics of the telescope. To meet the parameters required for accuracy, the mount to support the star cameras must be extremely rigid. The mount also follows tight criteria for its weight. This poster provides a detailed process of the construction of said star camera mount, including the research that went into the choice of materials, designing the 3D graphical model, running physical simulations on the model, and the assembly of the final product. The goal of this poster is to illustrate an example of the physics that goes into the engineering of experimental equipment, and to provide a glimpse into one of the many essential components of a large scale cosmological experiment.

SI - 127 Sirak Fessehaye, Howard University, *The effect of magnetic on the thermal energy of an object*

The Interplanetary Magnetic Field (IMF) is the general magnetic field of the solar system established by the solar winds given off by the sun. Due to the solar winds that establish the IMF battering the earth's magnetosphere, and several forces pushing the two away from each other, the earth's magnetosphere has a cavity shape and does not mix with the IMF. The purpose of this study is to examine the effect of a change in magnetic field on the thermal energy of an object. It will accomplish this by examining data from the ARTEMIS P1 and P2 satellites as the satellites transfer from the Interplanetary Magnetic Field and the magnetosphere during their orbit.

SI - 128 Nathanael Bodine, Berea College, *Developing High Entropy Alloys and the Impact of Annealing on the Crystalline Structures*

Our research was completed in effort to expand upon a research paper "Treasure Maps" for Magnetic High-entropy-alloys from Theory and Experiment which focuses on magnetic properties of certain high entropy alloys. During our research we explored the magnetic properties of high entropy alloys consisting of Chromium, Iron, Nickel, Cobalt, and a varying fifth transitional metal. While some of the magneto-caloric properties of these alloys have been theoretically mapped out, there has been little applied research on these alloys. My interest stemmed with the development and analysis of the high entropy alloys through an annealing process. My goal was to develop particular high entropy alloys and analyze the optimal annealment temperature to create the optimal crystalline structures. High entropy alloys have many useful characteristics that can be used in developmental research.

SI - 129 Elijah Nuss, Department of Physics, Pacific Union College, Angwin, CA 94508, *Measuring the Rovibrational State Distribution of a Small Diatomic Cation Produced by an ECR Ion Source*

We are presenting the three dimensional imaging technique that is currently developed at Pacific Union College to measure the rovibrational state of small diatomic molecular cations such as H_2^+, which is of special interest due to its fundamental aspects. This technique will be soon tested at Oak Ridge National Laboratory on molecular ions that are produced by an Electron Cyclotron Resonance ion source (ECR). A summary of few other methods that are published along with the comparison between techniques will be included.

SI - 130 Cameron Kimber, New Mexico Institute of Mining and Technology, *Light Curve for Brozovic 7295*

Observations of minor planet 7295 Brozovic were made using a CCD and 14 inch SC telescope over four nights, using MPO Canopus the data was reduced to light curves that reveal the rotational period.

SI - 131 **Mathilda Avirett-Mackenzie, Georgia Institute of Technology, *X-Ray Background Synthesis Modeling***
Our current model of the Cosmic X-Ray Background (XRB) is based on space densities of active galaxies, by far the largest source of x-rays, as predicted by a luminosity function (LF) with several unknown parameters. In this project, we create computational models of the XRB spectrum, each based on a specified published luminosity function. We then optimize the parameters for each LF based on observational constraints to create a library of accurate XRB models. We will utilize these models to investigate systematic uncertainties in synthesizing the XRB in the era of deep Chandra and NuSTAR surveys.

SI - 132 **Mackenzie Ridley, Berea College, South Dakota School of Mines and Technology, *Parameter Optimization for Porosity Reduction of Thin Film TiB2+AlMgB14 Laser Deposition on High Carbon Steel Tracks***
Many of today's industrial abrasives, blades, and cutting tools are composed of or protected by layers of a protective thin film. This film is a diamond coating, which because of its high cost and increased oxidation at high temperatures, can be unsuitable for some industrial fields. Certain ceramics, and in the case of this study, aluminum magnesium boride (BAM), provide cost effective thin films with adaptive qualities depending on the synthesis. In the case of the ceramic alloy BAM, qualities consistent of a high microhardness, low coefficient of thermal expansion, and a very low coefficient of friction can be synthesized. Research studies for stronger industrial tools that wear less over time will continue to grow and adapt as researchers understand more about various material properties. To better understand how various parameters affect the characteristics of BAM stated above, the processing parameter laser power was adjusted to study gas and powder pore concentrations within the deposited thin films. Selection of optimal laser power was accomplished through micro-ct imaging, microhardness testing, and scanning electron microscopy analyses.

SI - 133 **Cameron Sorensen, CSU Chico, *Modeling Convection in Stellar Dynamos***
Stellar variability is a key physical process that determines the potential habitability of planets. Stellar magnetism drives variability on short to moderate timescales by generating magnetic spots, which lead to explosive events such as flares and decadal variations due to activity cycles. Our Sun provides us with a unique opportunity to study stellar magnetic activity. By studying our Sun's magnetic activity we can then see how other stars' magnetic activity might affect their planets' habitability. Stellar magnetism comes from the convection and rotation deep in the stars' interiors. These magnetic fields can then rise to the photosphere where they are observed as sunspots. Rotational influences on deep convection then leads to differential rotation. We present simulations of the convective zones of sun-like stars using the Rayleigh code. Our simulations explore the impact of changing the level of the rotational constraint either by increasing the level of turbulence (by decreasing the level of diffusion) or by decreasing the rotational rate. Our simulations achieve solar-like differential rotation for solar-like conditions, however we also find that the stars with slightly less rotational constraint experience a clear change in their differential rotation profiles from solar-like (fast equator, slow poles) to anti-solar (slow equator, fast poles). In subsequent work we plan to add magnetic dynamo action to these models to explore how these changes in differential rotation alter the magnetic fields generated.

SI - 134 **Matthew Mircovich, University of Dayton, *Fabrication of Periodic Poled Lithium Niobate for Quasi Phase Matching***
Lithium Niobate (LN) is a crystal that has applications in the field of nonlinear optics. Poling LN allows for quasi phase matching and three wave mixing to be achieved by allowing longer length crystals without incurring a phase-mismatch penalty. Poling is the process of inverting the electrical domains of a material. Periodically Poled Lithium Niobate (PPLN) has a high degree of effective nonlinearity resulting from the increased interaction length, from sub-mm to several cm. Fabrication of PPLN crystals starts from a Lithium Niobate wafer doped with MgO. The wafer is periodically patterned with photoresist, then placed inside a conductive electrolyte solution. A high voltage is applied through the solution, contacting the wafer where the resist is absent. A 3-5 kV pulse is applied through the electrolyte, causing an domain reversal in the areas between the photoresist, hence leading to periodic poling. The fabrication of PPLN will be explored using various voltages, temperatures and periods. The fabricated structures will be tested in both frequency up conversion and down conversion experiments.

SI - 135 **Mark Giovinazzi, Drexel University, *BLAST-TNG Star Camera Baffles***
The BLAST-TNG experiment is a balloon-borne telescope with the goal of studying the effects magnetic fields have in star formation. It is launched from Antarctica and is chosen to fly in December; during this time of year in Antarctica, constant sunlight is unavoidable. While the experiment benefits from such conditions since it is powered by solar panels, the abundance of sunlight concurrently puts the efficiency of the BLAST-TNG star cameras at extreme risk. Although the cameras need to absorb photons from stars in front of them, the sun's immense power would otherwise blind the cameras with unnecessary light. In order to block all such light from reaching the lenses, star camera baffles are bolted onto the cameras. To enhance the design of the star camera baffles from previous flights, our structure is a truss made primarily out of carbon fiber tubing and plates. Contrary to the design of the star camera baffles from previous BLAST experiments, our new model is 40% taller and 40% lighter. A computer program was written to ensure that the truss structure was made in such a way that 100% of all undesired light would be blocked from reaching the cameras. The ultimate test for the star camera baffles will come when the BLAST-TNG experiment flies in December of 2017.

SI - 136 **Ariel Berrean, University of Florida, *Innovative Outreach at the University of Florida***
In collaboration with professors, graduate students, and volunteers, the University of Florida SPS chapter has revitalized its outreach program since the spring semester of 2015. Under the leadership of outreach chair Ariel Berrean, we began three new projects, in addition to expanding previous educational work. Our first project, launched in April of 2015, is a creative monthly event known as Physics at the Farmers' Market; students pick a topic (such as fluid mechanics or optics) and run demos and activities in our booth at the downtown Gainesville farmers' market, teaching patrons with fun and accessible physics. UF SPS also partnered with Physics Bus Gainesville in January of 2015 to do demo shows and bring interactive physics exhibits to schools and community events around the Alachua county area. Our newest project, started in August 2016, is partnering with local afterschool organizations that work with underfunded schools. We join them once a month to teach relevant physics topics (dependent on grade level and the needs of instructors), do mathematical arts and crafts, and give the students one-on-one assistance with math and science homework. In addition to these projects, we have increased our on and off campus involvement, appearing at local elementary school science nights, campus events like convocation and the college president inaugural celebration, and other off-campus educational events.

SI - 137 **Sandy Spicer, Siena College, *Probing Star Formation Rates and the Galactic Environment in MKW11 and NRGb004***
Morphology and environment are two factors that affect star formation rates in galaxies in field and cluster environments. We trace

where new stars are forming using a broad red filter and narrow-band imaging centered on the observed wavelength of H-alpha. This hydrogen recombination line signals the presence of ionized hydrogen gas and the young massive stars that ionize this gas. We reduce the imaging data for the galaxy groups MKW11 and NRGb004 taken at the WIYN 0.9 m telescope at Kitt Peak National Observatory (KPNO). We perform a qualitative analysis by comparing the star formation rates of the galaxies within these clusters based on morphology and galactic environment. Our next step is to quantify the relative extent of the star-forming and stellar regions to look for evidence of the specific environmental processes that could remove gas from galaxies such as ram-pressure stripping by the intracluster medium.

SI - 138 Wydglif Dorlus, Dillard University, *Polymer–inorganic nano-composite thin film upconversion light emitters prepared by double-beam MAPLE (DB-MAPLE) method*

The work was to investigate the possibility of making polymer–inorganic nano-composite films with upconversion fluorescence properties using the double beam matrix-assisted pulsed laser evaporation (DB-MAPLE) method. The existing pulsed laser deposition vacuum chamber was modified to accommodate two laser beams of different wavelengths for simultaneous ablation of two separate targets: a polymer host and a rare earth containing rare earth ion enriched upconversion fluoride dopant. The polymer target was prepared in chlorobenzene and kept frozen during the ablation with circulating liquid nitrogen in accordance with the MAPLE procedure. It was ablated with 1064 nm beam from a pulsed Nd:YAG laser. The pellets made of the synthesized powders of inorganic phosphors of $NaYF_4:Yb^{3+}$, Er^{3+} and $NaYF_4:Yb^{3+}$, Ho^{3+}were ablated with 532-nm beam from the same laser. The plumes from both targets were kept overlapping on the substrate during the deposition. X-ray diffraction analysis revealed that the most favorable for upconversion emission of the inorganic target materials was the hexagonal, betaphase of the $NaYF_4$ matrix existing at a baking temperature between 400 and 600 C. The fabricated nano-composite films were characterized using scanning electron microscopy (SEM), atomic force microscopy (AFM), transmission electron microscopy (TEM) and optical fluorescence spectroscopy. The polymer nano-composite films generally retained the crystalline structure and the upconversion fluorescence properties of the initial rare earth compounds due to better control of the deposition process of the materials with substantially different properties. The proposed method can be potentially used for making a wide variety of nano-composite films.

SI - 139 Nancy Pruett, Davidson College, *Solid State Synthesis of Fluorescent Minerals: Introducing S2- Centers into Synthetic Crystal Structures*

Scapolites ($Na_4Al_3Si_9O_{24}Cl$- $Ca_4Al_6Si_6O_{24}CO_3$) are a class of minerals which can exhibit bright yellow fluorescence under longwave ultraviolet light. We report the behavior of natural and synthetic scapolites as characterized by emission and excitation spectra at room and low temperatures. Fluorescent synthetic scapolites were made by solid state reaction replacing 0.2%, 2%, and 10% of Na_2CO_3 with Na_2SO_4. The fluorescent species has been identified as S_2^- whose excitation and emission can be modelled as electronic transitions coupled to quantum mechanical harmonic oscillator states in the ground and excited states. From the spectra, oscillator energy levels within the ground and excited states and the Huang-Rhys parameters were determined for the natural and synthetic scapolites. Mathematica was used to solve the quantum mechanical Schroedinger equation by the spectral method so that higher-order terms in the potential and, thus, the shape of the ground and excited state potential wells could be determined.

SI - 140 Vakini Santhanakrishnan, San Jose State University, *Studying Globular Clusters in NGC247 using Subaru Hyper Suprime-Cam*

We analyze and look for globular clusters (GC) around the nearby dwarf spiral galaxy NGC 247 which is about 3.5 Mpc away in the Sculptor group, based on wide-field imaging data from the Subaru Hyper-Suprime Cam, with a 1.5 degree view. The extremely wide-area coverage, depth, and image quality provide a potential watershed for studying globular clusters around nearby galaxies. The colors, magnitudes, and sizes of the globular clusters are examined and a count of the potential GCs is made. Spectroscopic follow-up is conducted to confirm the candidates.

SI - 141 Madison G. Masten, Santa Clara University, *Observation of coherent phonon oscillations in the Weyl semimetal SrMnSb2*

A class of materials called Weyl semimetals has recently attracted attention due to its members' novel electric properties, such as unusually fast electron mobility and electrons that behave like massless particles with fixed spin-chirality. We present our findings on one such material, $SrMnSb_2$, which has the added interest of being magnetic, unlike most Weyl semimetals (which break inversion symmetry). We show that pumping and then probing $SrMnSb_2$ with short pulses of 800 nm light produces distinct oscillations, or vibrational modes, which can consistently be resolved into several dominant frequencies. These frequencies do not shift as a function of magnetic field; thus despite the magnetic nature of $SrMnSb_2$, the vibrational modes we observed can be identified as phonons rather than magnons. In addition, we show that these phonons are Raman-active but not IR-active, consistent with the inversion symmetry of $SrMnSb_2$. Currently we are conducting experiments to determine whether the phonons we have identified are coherent or "squeezed"; the latter is a quantum state in which the phonon's uncertainty varies periodically between position and momentum.

SI - 142 Benjamin Avila, California State University, Fresno, *Optimal geometry of x-ray fluorescence arsenic detection in skin phantoms using an x-ray optics system*

Arsenic (As) is a well-known toxic element. While the toxicity of acute As poisoning was known for centuries, the adverse effects of long-term As exposure were the focus of more recent studies. The As exposure occurs via human consumption of contaminated well water - a naturally occurring problem in many parts of the world. The excess of As intake leads to its accumulation in keratin-rich tissues such as skin, nails, and hair. Skin is less prone to external As contamination, hence, a better biomarker than nails or hair. X-ray fluorescence (XRF) uses characteristic x-ray emissions to detect elements in trace concentrations of a few μg/g or lower. Low radiation dose studies with portable spectrometers demonstrated the method's potential for the assessment of As exposure, particularly in remote parts of the world. However, the method was not optimized for superficially distributed As within the skin. In this study the sensitivity of As detection was found to reach a maximum for a 5-degree angle between the skin phantoms and the incident x-ray beam. An x-ray optics system, x-ray detector, and a positional stage assembly were used to measure the As $K\alpha$ and $K\beta$ peak amplitudes in skin phantoms with 0, 4, 6, 8, and 12 μg/g As concentrations.

SI - 143 Samuel Frederick, Davidson College, *Determining the Excitation Temperature of M57 via Analysis of Forbidden Spectral Line Ratios*

Planetary nebulae such as M57 are irradiated by the intense energy output of a central white dwarf star. Given the low density of planetary nebulae, most emission transitions do not occur due to collisional de-excitation. Rather, a large majority of spectroscopic emission lines in planetary nebulae are due to forbidden transitions between meta-stable states, the most prominent of which are

[NII] and [OIII]. Knowledge of the distribution of level populations within these species allows for the determination of the excitation temperature of the gases.

During the 2016 CUREA summer research program at Mount Wilson ObservatoryI performed a spectroscopic study of M57 with the goal of determining the excitation temperature of [NII] and [OIII] within the nebula. Data was attained using an SBIG Self-Guiding Spectrograph mounted to a Meade 16" Schmidt-Cassegrain telescope. Calibration of the CCD data was necessary given the sensor's quantum efficiency and non-uniform response across the electromagnetic spectrum. Left-handed Riemann sums were approximated for each line of interest to determine the population ratios of excited states. Some difficulty occurred in determining the populations of two key emission lines that were statistically insignificant against the variance of the background noise due to light pollution. Using the Boltzmann equation population ratios for [NII] and [OIII] were input to determine a result of 11800 K which lies within 11% of published values."

SI - 144 Aaron Strom, University of Wyoming, *Probing a Quantum Solid with Deuterated Acetylene*

The condensed phase is often thought of as a rigid, bulk composition of particles with severely restricted degrees of freedom—perhaps limited only to vibrational modes. In 1930, meditations on molecular rotation within crystals led Linus Pauling to the deduction that this behavior is merely natural, so long as the molecule in consideration possesses the appropriate mass and rotational quantum numbers. Little did he know, dynamical phenomena proliferate through other states of matter, like the quantum solid: a highly ordered array of particles capable of relatively large scale zero point motion about their mean lattice positions. Helium-4 is well known for superfluidity below the Lambda point, but a quantum solid will emerge with pressure and cooling. It turns out that there are only two known quantum solids, the second being solid parahydrogen (pH2); "normal hydrogen" comprises of a 3:1 ortho-/para-H2 ratio as a consequence of nuclear-spin statistics. Homonuclear molecular hydrogen lacks a transition dipole moment, however, the infrared signature of solid pH2 arises due to subtle anisotropic crystal field interactions that distort its spherical symmetry. In situ matrix isolation spectroscopy of a molecular probe such as dideutero-acetylene (DCCD) dispersed in crystalline pH2 via a rapid vapor deposition technique illuminates perturbations influencing the potential energy surfaces of the probe and host of this condensed phase environment. In this work, high-resolution FTIR spectra of DCCD-doped pH2 crystals recorded in the low-temperature regime (1.6-4.3 K) are presented. In particular, the rotational motion of DCCD about a pH2 vacancy will be elucidated.

SI - 145 Stuart Bivens, University of Oregon, *A Mechanical Model of Cell Death Due to Beta Lactam Antibiotics*

The current understanding of how beta lactam antibiotic lyse cells is through disruption of the production of the rigid cell wall. Turgor pressure pushes the cell membrane out through pores caused by these disruptions and bursts the membrane open. Our research looks to describe the death of these cells using a mechanical model that can make predictions about how and when the cells burst.

SI - 146 Andrea Santiago-Boyd, Ithaca College, *Constraining the Surface Magnetic Field of AGB Stars*

Context. The shaping of planetary nebulae has been a subject of serious debate in previous years. Some believe that the central stars' late stages of life may contribute to the many shapes that are observed. Studies suggest that magnetic fields in the Asymptotic Giant Branch (AGB) stars may play a role in the shaping of the subsequent planetary nebula. If these magnetic fields are present they should lead to x-ray emissions.

Aims. Use the x-ray emission from the stars to constrain the surface magnetic field.

Methods. Using data form ESA's XMM Newton we will use the relationship between x-ray luminosity and magnetic flux to find a surface magnetic field. The surface magnetic field strength measured for χ Cyg will be used to constrain the filling factors needed to constrain the magnetic field.

Results. From the XMM observationsT Dra was the only x-ray source out of the 6 that were observed. We were able to constrain the filling factors to values less than 10-3 and the surface magnetic field strengths to 500-5G.

Conclusions. Getting constraints for the surface magnetic field is a difficult task. To better our results we need to get better x-ray observations of χ Cyg. We can then re-evaluate the constraints on the filling factorwhich in turn will hopefully improve our values for the surface magnetic fields."

SI - 147 Elizabeth Pham, California State University, Chico, *Determining the Surface Free Energy of Marine Alga Emiliania huxleyi with Spectrophotometry*

Marine alga Emiliania huxleyi (Ehux) is the most abundant coccolithophore in the world and a promising source for sustainable biofuel. We studied the surface free energy (SFE) of Ehux cells, particularly as the cells' lipid content and locations change with age. We administered a newly-developed spectrophotometric assay to determine the SFE of Ehux. Although our current procedure cannot yet be replicated with polystyrene microspheres, we have reason to believe that adding a fluorescence reading to the procedure provides more accurate and sensitive data when determining the SFE of algal cells. The next step would be to perfect the assay using the microbeads and apply it to the Ehux cultures.

SI - 148 Jacob Herman, Augustana College, *Light Output for Unbound Neutron Emission and Simulation Comparison*

Studying nuclei that have extreme ratios of protons to neutrons continues to be an interesting topic in the field. These nuclei are often studied while in an unbound state that decays into a neutron and charged fragment. These nuclei are produced for experiments at the National Superconducting Cyclotron Laboratory at Michigan State University. After the decay, a superconducting Sweeper magnet bends the charged particles away from the neutrons so that they may be detected by the Modular Neutron Array (MoNA) and the Large multi-Institutional Scintillator Array (LISA). The neutron detectors are made of plastic scintillating plastic that measure light output using pairs of photomultiplier tubes, one on each end. MoNA and LISA allow us to measure neutron time-of-flight as well as position. From this we can measure the neutron four-momentum vector needed to reconstruct the energy of unbound states. When we compare it to simulation and prior results using GEANT4, it can help us better understand the structure of the unbound nucleus. Comparison of data to simulation will be presented.

SI - 149 Stephanie Hadley, San Jose State University, *Stellar mass vs. stellar velocity predictions from the Bolshoi-Planck simulation using Age Matching*

A 2011 study compared the rotation velocity of spiral galaxies and the velocity dispersions of elliptical galaxies with predictions from the high-resolution λCDM n-body Bolshoi cosmological simulation in which stellar masses were assigned to galaxies using abundance matching, and the predictions rather well reproduced the observed Tully-Fischer and Faber-Jackson relations. In 2013 it was shown that putting old red galaxies with little star formation in early-forming dark matter (DM) halos and young blue galaxies with ongoing star formation in late-forming halos, a method called Age Matching, correctly predicts the spatial correlations of red and blue galaxies. In order to obtain a better understanding of galaxies and their associated DM halo properties, we use a simulation with updated cosmological parameters, the Bolshoi-Planck simulation, and we study the effects of applying different Age Matching assumptions. The previous work calculated the circular velocities of galaxies at a radius of 10 kpc assuming that all the stellar mass was within that radius. We will improve the analysis by considering the statistics of more massive galaxies for which the stellar mass is more broadly distributed. Our preliminary results show that galaxies of the stellar mass residing in early- forming halos have higher circular velocities compared to those residing in late-forming halos. This resembles the observational data where early-type galaxies have higher circular velocities than late-type galaxies. For a more comprehensive analysis, we will consider different populations for Age Matching applications with an alternative method to model DM profiles in future work.

SI - 150 Nicole Hudson, University of South Florida, *Searching for the Upper Bound of Images Produced by a Gravitational Lens*
The possibility of light being bent by massive objects was first proposed as early as the late eighteenth century, but such phenomena were not mathematically formulated until Einstein developed his Theory of General Relativity in the 1910s. It was not until the late twentieth century that physicists discovered that they could use the robust techniques of complex analysis in order to model gravitational lensing, and they developed what is now called 'the lens equation'.

Today astrophysicists and complex analysts alike are interested in determining an upper bound for the number images produced as a light source passes through a gravitational lens such as a galaxy. The maximum number of images produced by a particular type of lens corresponds directly to the maximum number of roots of the lens equation (a harmonic polynomial) for a particular galactic model. For this purpose there are two different ways of representing a galaxy: approximating the galactic bodies as a finite collection of point masses or approximating the entire galaxy as a continuous mass distribution.

This presentation will begin with a bit of history about gravitational lensing. The lensing equation will then be explainedwith both types of mass representations considered. Computer generated examples of each will be displayed. Additionally various techniques which are utilized in the process of finding the roots of the lensing equation will be discussed. At the end of the presentation future avenues for research of this open problem will be mentioned."

SI - 151 Diego Fausett, University of Texas at San Antonio, *Optical Properties of Gold-Silver Nanoparticles*
Plasmonic metal nanoparticles have found many applications in chemical and biological sensing applications, especially Surface Enhanced Raman Spectroscopy (SERS). SERS probes the vibrational modes of organic molecules, which allows us to measure their "molecular fingerprints" to specifically identify them. Au@AgAu yolk-shell cuboctahedral nanoparticles are a very promising SERS substrate due to their high surface area to volume ratio; however, it is first necessary to fully understand their optical properties. Bulk UV-vis spectroscopy of these particles reveals a strong extinction peak at 521 nm and a shoulder in the 620-680 nm range, possibly reflecting additional localized surface plasmon resonance (LSPR) modes. Here, we studied these particles' optical properties at the single particle level, and hypothesized that the scattering spectra of individual Au@AgAu yolk-shell cuboctahedra will exhibit two or more distinct plasmon modes. We further hypothesized that the exact wavelengths of these plasmon resonances will vary significantly from particle to particle, giving rise to the shoulder seen in ensemble measurements. Single particle scattering spectra were collected using dark field microspectroscopy and correlated with scanning electron microscopy in order to study the relationship between the plasmon peaks and nanoparticle structure. To date we have observed single nanoparticles exhibiting 1-3 plasmon modes, with further studies ongoing. Our results fulfill two purposes: (1) Establishing the fundamental optical properties of this newly described material, and (2) assessing the potential of these particles as a SERS substrate.

SI - 152 Jeremy Thurston, Southern Illinois University Edwardsville, *Investigating the Effects of the Lennard-Jones Potential on Icosahedral Rare Gas Clusters*
Matter's behavior can change drastically depending on the conditions imposed on it. We use molecular dynamics to simulate the Free-electron LASer in Hamburg, Germany (FLASH) emitting an ultra-high laser beam with a wavelength of 100nm onto a nanoscopic clump of Argon. We model the cluster classically, but in some cases, it needs an additional quantum mechanical modification on top of the ionization rates which are quantum mechanical but modeled classically. The Lennard-Jones potential provides the repulsive force in extremely close regimes that we observe experimentally. This has been found to be crucial in our model of the laser-cluster interaction to correctly model the low-intensity regime. While not the usual focus of experiments, the low-intensity regime is needed in order to replicate the experimental signal due to the spacial distribution of the laser pulse. Here, we observe the effect of the implementation of the Lennard-Jones potential on Argon clusters. With this modification, we investigate the effects of our simulation by comparing the average charge state populations as a function of time.

SI - 153 Peyton Nanney, University of Tennessee, Knoxville, *Perovskite Compound Synthesis via Solid State Reaction*
Pulsed layer deposition (PLD) is a technique used to grow thin films and orderly atomic layers upon a substrate via laser induced ejection of vaporized high phase purity precursor material. This research was conducted to find the optimal process to synthesize and condense pure phase Perovskite compounds to be used as precursor targets in later PLD experiments. We aimed to determine the optimal process to create $CaZrO_3$, $BaZrO_3$, $CaTiO_3$, and $BaTiO_3$ precursor targets. Solid state reactions were used and involve the mixing and heating of stoichiometric amounts of initial powder material to create the desired compound. Different powder precursors, grinding intensities and heat cycles were experimented with to determine the best process for material synthesis. X-ray diffraction and X-ray spectroscopy were then used to determine the purity and composition of synthesized materials. Once a material of desired purity has been created, it was then pressed and sintered to form very dense pellets. The effectiveness of the use of a binding agent in the pressing of the pellets was explored as well as varying sintering temperature. A successful process for synthesis of very dense and pure $CaZrO_3$ and $BaZrO_3$ targets from precursors was found. A process for synthesizing $CaTiO_3$ and $BaTiO_3$ was also determined. It was observed that the use of a binding agent does result in denser pellets for sintering temperatures below 1500°C. This work provides the base material for future experiments to determine physical properties of materials.

SI - 154 Caroline Bowen, University of Tennessee, Knoxville, *Die-cut Colored Paper Illustrations of Mathematical Functions*
As an artist, my work is focused on creating novel, physical visual aids for math and physics, with an emphasis on affordability and accessibility for students and educators. This past January I began exploring paper as an artistic medium, drawing inspiration from pop-up books as a way of creating cheap and effective 3D illustrations. As of this summer, this has evolved into accordion-style cutout "greeting cards" depicting Taylor expansions and special functions, and these in turn evolved into 3D contour surfaces formed from layers of die-cut colored cardstock mounted on rods and separated with spacers. For both of these projects, the graphs are plotted in Mathematica, the graph lines converted into paths and imported into Adobe Illustrator for layout and formatting, and then cut using a Silhouette Cameo die-cutting machine.

While I am happy with the accordion cards and feel they have reached their finalized formI am still actively pushing the boundaries of the paper 3D surface format: tackling different construction problems (particularly with maxima and minima) experimenting with hand-dyeing the paper for more control over color gradients making increasingly complicated surfaces, and searching for new concepts that could be illustrated through this format in an insightful and meaningful way.

My ultimate goal with these two projects is to build a physical reference library of important and interesting mathematical functions that is both useful and beautiful and can be easily replicated by others or purchased at low cost."

SI - 155 Jiyoung Hwang, Green River College, *Aerodynamic wing design using Bernoulli's principle*
Holes in the modified wing yield multiple possible benefits. Starting at the leading edge, longitudinal holes are placed at the stagnation area where the air gets trapped when trying to run either above or below the wing. Our hypothesis is that this should allow the air in that area to flow into the wing and out the exit near the ailerons, thus reducing the drag it would otherwise create. Horizontally-flowing air can create a venturi effect and, by Bernoulli's principle, cause a lower pressure inside the holes. This low pressure would draw in air through the vertically situated holes, creating suction on the upper surface of the wing. With this overall effect, the airflow over the wing would get sucked down at slower speeds than otherwise. We hypothesize that the air being held to the wing in this way would allow for slower speeds without losing lift or going into a stall.

SI - 156 Demetrius Almada, Department of Physics & Astronomy, San Jose State University, *How quantum is the D-Wave Two "quantum computer"?*
The prototype quantum computer, the D-wave Two machine, utilizes superconducting circuits to create arrays of controllable and interacting quantum bits (qubits). Unlike classical bits, which can only take two values, 0 and 1, qubits are capable of storing much more information since their state can be a superposition" of 0 and 1. This allows the machine to solve classically-hard problems by adiabatically quenching quantum fluctuations. Important questions about the performance of the D-wave chip and the quantum nature of the annealing process have been raised. For example, D-wave's typical time-to-solution has been shown to scale unfavorably with the hardness of the problem as compared to analogous classical algorithms. Here, we implement a state-of-the-art algorithm for solving random Ising models on classical computers called Parallel Tempering, and aim at exploring the nature of the hard instances of the model which lead to "temperature chaos" and orders of magnitude longer simulation times.

SI - 157 Jacob Maibach, The George Washington University, *Theoretic Foundations of Cutoff-Clustering in Analysis of Transcription Factor Distributions*
Transcription factors (TFs) are protein complexes that bind to DNA and regulate gene expression. They form large regulatory networks which give rise to much of the complex biology in large organisms such as humans. Understanding the group behavior of TFs is therefore a prominent focus in current genetics research.

Much recent work on TFs utilizes a type of clustering analysis called cutoff-clustering. Treating TFs as points along a 1d DNA sequencethey are clustered according to a characteristic length-scale. Although this method is well-established its theoretical foundation is lacking. In particular we focus on two questions: Why use cutoff-clustering? How do you choose the characteristic length-scale?

To address the first questionwe present a way to realize cutoff clustering via application of a simple thermodynamic model (the Ising model) thus showing it is a natural choice given a few weak assumptions. To address the second question we present an optimization method in which choosing a length-scale corresponds to maximizing a clustering score. This reduces the problem of choosing a length-scale to one of choosing a scoring method. Lastly, we introduce a selection criterion to guide the choice of scoring method.",

SI - 158 Alexa Zeryck, University of Oregon, *Analyzing W' Decay*
Rationale: The W' boson is a possible extension to the Standard Model, yet not much is known about how its decay would be characterized in a particle detector.

Purpose: The purpose of this study was to analyze particle collision data in order to find the best methods for singling out W' decay events. Specificallythis study intended to investigate whether results would change if jets were merged.

Methods: A sample of simulated events was read in and analyzed using the program ROOT. Events were categorized by the number of jets presentand subcategorized by the presence of jet clusters. Quantities such as jet pT jet mass cluster mass, and delta R between jets were recorded and plotted in histograms.

Results: The majority of events that indicated W' decay were events with three hard jets and several soft jets in the opposite hemisphere as the lead jet. When the four-vectors of the jets in the opposite hemisphere were added togetherthe resulting mass distribution had a peak at the mass of the top quark. When adding the third- and fourth-hardest jets together the resulting mass tended towards the mass of the W.

Conclusions: At mid-range energythe W' boson tends to decay into four or more jets although these jets can be retroactively merged to recreate the expected decay products."

SI - 159 Harrison Hartle, University of Alaska, Fairbanks, *Vortex Dynamics in Quasi-Two Dimensional Turbulence*
We numerically and analytically study the dynamics of vortices that arise in quasi-two dimensional fluid turbulence. Vortex motion is a challenge in its own right, and important for the basic structure of turbulence. Our model addresses the fluid dynamics of confined plasmas and planetary atmospheres. A variety of vortex behaviors are exhibited in our numerical experiments, including individual vortices, steadily-traveling vortex pairs, several three-vortex phenomena, and complex multi-vortex interactions. Some of our techniques of investigation include applying analytical considerations directly to the equations of motion and approximations thereof, variation of trial parameters that influence vortex behaviors, creation of simplified models which emulate the vortex dynamics, and a variety of methods of data analysis.

SI - 160 James Mallon, Abilene Christian University, *Construction and Upgrades in Drift Chamber 05, Designed for the COMPASS II polarized Drell-Yan experiment*
The COMPASS project is a fixed-target nuclear physics experiment at CERN which explores the internal structure of the proton, and COMPASS II's polarized Drell-Yan experiments will be exploring the quark angular momentum contribution to the spin of the proton through Semi-Inclusive Deep Inelastic Scattering. As a part of this process, Drift Chamber 5 (DC5), based on DC4 built by CEA-Saclay must be constructed to replace an older, faulty straw chamber. The 23 total frames of DC5 have an outside measurement of 2.94m by 2.54m, with the 8 anode frames (x, x', y, y', u, u', v, v') having a total of 4616 >2m-long wires, giving a detection region of 4.19m^2. In order to solve left-right ambiguity, the prime planes are shifted by 4mm, or one drift cell. The x- and y-frames have 513 wires strung across them, half being ¯100µm at 400g of tension, and half being ¯20µm at 55g on the x-frames, while the y-frames' ¯20 µm wires are under 70g of tension. The planes at ±10¡ (u, u', v, v') will have 641 wires, with the ¯100µm wires at 400g, and the ¯20µm wires at 55g. DC5 will also have an updated front end electronics setup, using a new pre-amplifier-discriminator chip, in order to allow the recording of more events per second. These updates will improve tracking of particles, but have led to interesting challenges, which were solved in varying ways.

SI - 161 Mia Vega, University of the Sciences, *Physics Wonder Girls Camp for Middle School Girls at Usciences*
Physics Wonder Girls Camp, located at the University of the Sciences, was a three day summer camp for selective middle school aged girls. Funded by the National Science Foundation, the free camp was directed by Dr. Roberto Ramos and assisted by physics major students who attend USciences. The outreach camp's objective was to encourage and/or grow young girls' interest in physics through hands-on experiments, games, and career talks. Some of the activities the campers were able to experience included building a submersible, riding a hovercraft, and walking on non-Newtonian fluids. In addition to exciting demonstrations, the campers learned about career options within the field of Physics in areas such as cosmetics and food. The girls were able to demonstrate all that they learned in a presentation to their family and friends on the last day.

SI - 162 Jeffrey Butler, Morehouse College, *Liquid-Mediated Adhesion between Contacting Rough Surfaces*
The proposed project is a 3-year theoretical and experimental investigation of liquid-mediated adhesion. The proposed work is motivated by the quest to understand the tensile stresses exerted by liquids within small channels and to help mitigate the problem of "stiction" that is prevalent in micro and nano scale devices. Measurements of flow rate, tensile force, surface deformation and friction force will be performed for interfaces involving liquid interposed between solid bodies of prescribed surface roughness. In parallel with the experiments a model of elastocapillarity will be developed to describe the 3D flow of a thin liquid film at the interface between contacting rough, elastic surfaces. This work will assess the validity of the notion of interface collapse as predicted by recently published mathematical models in the literature. This investigation will also serve to establish new lower bounds on the magnitude of negative capillary pressures generated in narrow interfaces.

SI - 163 Nyles Fleming, Morehouse College, *Large Micro-channel Oil Sepreration Device*
Municipalities worldwide are being challenged with the task of keeping the sewer collection systems free of fats, oil, and grease (FOG). FOG can potentially hydrolyze and release free fatty acids that react with calcium to form saponified solids. These hard, insoluble, solids can adhere and accumulate on pipe walls that lead to pipe blockages and cause sanitary sewer overflows (SSOs). SSOs can potentially release untreated raw sewage into streets as well as commercial and residential facilities. To prevent these hard formations from causing blockages, grease interceptors are used to gravimetrically separate out FOG prior to discharge into sewers. Current method to testing the removal performance of these grease interceptors has proven insufficient. Recently, a team of scientist at University of Tsukuba developed a device that produces micro sized oil globules in a uniform manner. These micro-sized oil globules could be a way to test grease interceptor's ability to remove FOG before discharged into sewers. In our research, we seek to recreate Tsukuba's device. We will try to replicate this device with simple materials through 3D printing to determine if the behavior and uniform size of these droplets can be developed using this cheaper manufacturing alternative. We will also explore alternative methods to replicate the behavior of FOG in wastewater. One alternative is to employ the use of glass microspheres that represent the same density and size as specified oil globules. Overall, the goal of this research is to study FOG behavior in grease interceptors to reduce SSOs in municipalities worldwide.

SI - 164 Letrell Harris, Hampton University, *The PHantastic (Physics) voyage at Hampton University*
The Physics Department at Hampton University offers BS, MS and PhD degrees in physics and is the only one at a Historically Black College offering graduate degrees in nuclear and medical physics. A September 2016 U.S. News and World Report report ranked Hampton University as #3 across all HBCUs while in 2015 its Physics Department was ranked as the best across all HBCUs by HBCU Colleges. Undergraduate students are extensively involved in fore-front research in optical, material, nuclear, accelerator and medical physics. During the 2015-2016 academic year, the Department launched a "PHantastic (Physics) Voyage" outreach program during the annual 2016 Conference on the Black Family that combined most of the outreach activities within the Department. In the Fall 2016, a component focusing on a monthly demo/meal event on campus is being implemented, along with weekly physics and math tutoring sessions for high school students aimed at providing college credits. We will provide an overview and current status of this program along with future plans.

Saturday, November 5 - Session II

SII - 1 Eryn Cangi, University of Oregon, *Delineating the Migrating Solar and Lunar Semidiurnal Atmospheric Tides in the General Circulation Models*

During periods of Sudden Stratospheric Warming (SSW), disturbances couple the lower atmosphere to the ionosphere, inducing plasma density fluctuations of 50-150% in the low-latitude F-region. Understanding the coupling mechanisms is important to the prediction of space weather and the operation of satellites in low Earth orbit. This necessitates the ability to accurately quantify the amplitudes and phases of the solar (SW2) and lunar (M2) migrating semidiurnal tides. In most cases, SW2 is much larger in amplitude than M2 in the lower thermosphere, but in periods of SSW, M2 becomes comparable in magnitude to SW2. As the two tides have very similar periods, they are difficult to separate. In our study, we first remove SW2 from data before fitting the lunar component of the tidal function. We then compare our results to that of an earlier method used by Maute et al. [2016], which did not remove SW2 first. Accuracy tests on synthetic data of our method show that the percent error of M2 amplitudes is 1.42% for data resolution of 1 hour. We then apply our method to data generated by TIME-GCM. In comparing our results to those of Maute et al., we see good agreement in amplitudes of M2 in the Northern Hemisphere. However, in the Southern Hemisphere, there is a slight increase (~6.25%), likely due to other effects not accounted for in this project. With further work, we believe our method has promise as a clearer way to delineate M2 and SW2.

SII - 2 Matthew Knodell, St. Mary's University, *Computation of the exciton ground state in arbitrarily shaped quantum dots using discrete variable representation method*

The sinc-function discrete variable representation method is used to calculate the ground state energy of an electron and its corresponding hole bound inside quantum dots of varying shapes in the strong connement regime. Under the eective mass approximation, a time-independent Schrödinger equation is numerically solved for the two-particle system with the innite potential well used to model the dot boundary and the direct electrostatic Coulomb force used to describe the interaction between the particles. Using dot shapes of known energy values, in particular the spherical and ellipsoidal quantum dots, the method was veried and tested for convergence along with an analysis of the level of sparsity of the Hamiltonian matrix which could be helpful to maximize memory eciency for future problems. The calculations of CdSe rod-shaped quantum dots were compared to actual photoluminescence spectra, and good agreement (3% or less percent dierence) was found when the rod width was between 4.8 and 6.4 nm, hovering around the CdSe Bohr exciton radius of 5.6 nm.

SII - 3 Talha Rehman, Berea College, *The CLAS12 Forward Tagger Detector at Jefferson Lab*

The CLAS12-Forward Tagger is designed to detect electrons produced by the interaction of CEBAF 11 GeV electron beam with the target. This detector is composed by an electromagnetic calorimeter (FT-Cal), based on lead tungstate scintillating crystals, a hodoscope (FT-Hodo), based on plastic scintillator tiles and two layers of Micromegas trackers (FT-Trck). The Forward Tagger is designed to measure electrons scattered between 2.5 and 5 degrees. Before the installation in the Hall-B of Jefferson Lab, the FT has been assembled in the laboratory and is currently tested with cosmic rays. The calorimeter response is being measured to perform the energy calibration of the system. Cosmic rays crossing the calorimeter crystals release on average a fixed amount of energy that can be used to determine the absolute calibration of the system. The stability of system response can be monitored by studying the variation of calibration constants as a function of time. The results obtained in a few weeks of operation indicates that the energy response of the calorimeter is consistent with expectations and does not show significant time-dependence.

SII - 4 Robert Valdillez, North Carolina State University, *Measuring the Neutron Spectrum of 250Cf with a Time of Flight Measurement*

Neutron calibration sources are usually primarily 252Cf with a small fraction of 250Cf when produced. The half-life of 250Cf is 13 years, while the half-life of 252Cf is only 2.6 years. 252Cf decays into 248Cm which has a very long half-life of 340,000 years. As a result of the different decay rates, old Cf sources now contain a higher percentage of 250Cf. The neutron spectrum of 252Cf is well known, however 250Cf has not been measured. Determining the neutron spectrum of 250Cf is necessary because instrument calibration is done using these old 252Cf sources under the assumption that the neutron spectrum of 250Cf is the same as 252Cf. Our experiment will test the validity of this assumption and provide the necessary information to be used in precision device calibrations performed in the future. We measure the neutron spectrum using a time-of-flight technique. The measurement works by determining the time difference (and thus neutron energy) between prompt gamma rays detected in a NaI crystal detector and neutrons detected in an organic liquid scintillator detector placed 2.61 m apart. Backgrounds were accounted for by taking two sets of data; one set was taken with a shadow cone and the other was taken without. Subtracting data taken with a shadow cone from data taken without a shadow cone eliminates background data. My poster discusses the uncertainties in the measurement, experimental set up, data acquisition, data analysis, and results.

SII - 5 Daniel Terrano, Cleveland State University, *Light Scattering Study of Mixed Micelles Made from Elastin-Like Polypeptide Linear Chains and Trimers.*

Temperature sensitive nanoparticles (E20F) were generated from a construct of three chains of Elastin-Like Polypeptides (ELP) linked to a negatively charged foldon domain. This ELP system was mixed at different ratios with a single linear chain of ELP (H40L) which was deprived of the foldon domain. The mixed system is soluble at room temperature and at a transition temperature will form swollen micelles with the hydrophobic linear chains hidden inside. This system was studied using Depolarized Dynamic Light Scattering (DDLS) and Static Light Scattering (SLS) to model the size, shape, and internal structure of the mixed micelles. The mixed micelle in equal parts of E20F and H40L show a constant apparent hydrodynamic radius of 40-45 nm at the concentration window from 25:25 to 60:60 µM (1: 1 ratio). At a fixed 50 µM concentration of the E20F with varying H40L concentrations from 5 to 80 µM, a linear growth in the hydrodynamic radius is seen from about 11 to about 62 nm, along with a 1000-foldincrease in VH signal. A possible simple model explaining the growth of the mixed micelles is considered. Lastly, the VH signal can indicate elongation in the geometry of the particle or could possibly be a result from anisotropic properties from the core of the micelle. Static Light Scattering was used to study the molecular weight, and the radius of gyration of the micelle to help identify the structure and morphology of mixed micelles and the tangible cause of the VH signal.

SII - 6 Connor Murphy, Grove City College, *Development of Aluminum-Air Fuel Cells and Aluminum Iodine Batteries as Energy Storage Devices*

Aluminum-air fuel cells and aluminum-iodine batteries are attractive as energy storage devices because of their high energy density and low cost materials compared to such devices as lithium-ion batteries. Aluminum-air has a higher energy density than aluminum-iodine, but the aluminum anode undergoes detrimental corrosion in a basic electrolyte. Aluminum-iodine batteries use a neutral electrolyte, which is safer and potentially more efficient. This project explored methods for reducing the corrosion of aluminum in a basic electrolyte, effective separators for both types of devices, and practical designs for testing both aluminum-air and aluminum-iodine technologies for the purpose of improving efficiency and performance. It was found that by using a 4:1 ratio methanol-water solvent the corrosion rate could be reduced by a factor of five. Furthermore, a poly-vinyl alcohol sheet proved to be a reproducible and efficient separator for aluminum-air fuel cells, but not for aluminum-iodine batteries, which used the electrolyte as a separator.

SII - 7 Rosa Wallace, University of Colorado Denver, *Three-Dimensional Potential-Field Source-Surface Modeling of the Evolution of Coronal Structures*
White-light images of the solar corona indicate that the global structure of the corona evolves as a function of solar cycle phase. Building a three-dimensional potential-field source-surface model of the corona, we investigate how the longitude-dependence of coronal structure varies with cycle phase. Using white-light coronal images from the Mauna Loa Solar Observatory (MLSO) as guidance, we derive the global three-dimensional corona from our model as a function of Carrington rotation, focusing on the most recent three solar minima in 1986, 1996, and 2008, using a linear combination of spherical harmonics combined with a radial boundary condition at the source-surface, taken at 2.5 solar radii. The coefficients of spherical harmonics up to the fifth degree, as well as their phase, are deduced experimentally by comparing model-output with MLSO observations. We find that (i) during typical solar minima, although the axial dipole dominates, small, time-varying multipole contributions are present when analyzed over a few rotations. In addition, we find that (ii) the unusual minimum in 2008 is multipole-dominated in contrast to the previous two minima. (iii) The signature of a quadrupole contribution in the 1996 corona and the increase of multipole components in the 2008 corona indicate that the departure from dipole at minimum originated during 1996. Further analysis of the present corona is likely to indicate that the next solar minimum will be non-dipolar. Our estimates of the variation of multipole contributions as a function of time can be used to constrain models of the three-dimensional solar dynamo.

SII - 8 Tymothy Mangan, Oregon State University, *A multipurpose test stand for scintillator decay lifetimes*
We built a prototype test stand in order to measure novel scintillator materials' decay lifetimes. Radiography and imaging are valuable diagnostic tools for studying dynamic experiments, thus new scintillator materials are needed to improve the resolution of the current observational systems. A collaborative effort by the neutron imaging and x-ray radiography teams is underway to study the novel scintillator materials developed at LANL and by outside collaborators. Decay lifetimes are an important characteristic of a scintillator material and so by developing this prototype we have provided an avenue to further scintillator development. We confirmed the effectiveness of this prototype by comparing known scintillator decay lifetimes of LYSO and polystyrene samples. In our proof-of-concept prototype we use an 80 Gs/s oscilloscope. With future implementation of a fully developed test stand, we will use a digital data acquisition system to record complete waveforms to conduct a post-processing analysis of the decay times. Results of the prototype test and potential improvements to final test stand design will be presented. LA-UR-16-25229.

SII - 9 Deepsana Shahi, Adelphi University, *Error Analysis of CEBAF Emittance Measurements*
In the Continuous Electron Beam Accelerator Facility (CEBAF) at Jefferson Lab, the errors in the measured emittance and Twiss parameters are computed from errors in the measured beam sizes. For each measurement, the beam goes through a quadrupole and the wire scanner (or harp) where the beam profile measurements are collected by measuring the harp signal intensity and position as its wire passes through the beam. The measured square beam sizes are calculated by fitting harp data to Gaussian. The analysis of the square beam sizes as a function of quadrupole strength gives emittance and Twiss parameters. By propagating measured errors in the square beam sizes, the error bars for emittance and Twiss parameters are calculated.

SII - 10 Samantha Spytek, Virginia Polytechnic Institute and State University, *Planning for the Future: Revealing Underrepresented Stories in the History of Physics*
Women and minorities are underrepresented in the landscape of the physical sciences - both in numbers and visibility. This summer, we built on four years of previous interns' work, revising and writing 40 teaching guides that highlight the often forgotten contributions of women and minorities to the physical sciences. We have ensured that these teaching guides meet national educational standards, can fit into social and natural science courses, and are available for free online. We intend for these resources to be easily integrated into classrooms from the first grade through the college level, and that they will provide students with a diverse set of role models while also calling attention to ongoing diversity issues in STEM.

SII - 11 Noah Frere, University of Tennessee, Knoxville, *Analysis of Gravitational Wave Signals from Core-Collape Supernovae Using Matlab*
When a heavy star runs out of fuel, it collapses under its own weight and rebounds in a powerful supernova explosion, sending, among other things, ripples through space-time, known as gravitational waves (GWs), which can be detected by earth-based observatories, such as the Laser Interferometer Gravitational-Wave Observatory (LIGO). Observational scientists must compare the data from GW detectors with theoretical waveforms in order to detect the GW signals. These GW waveforms coming from CCSNe can only be produced by computer simulations. The UTK/ORNL astrophysical group has performed such simulations. Here, I analyze the resulting waveforms, using Matlab, to generate the fourier transforms, short time fourier transforms, energy spectrums, evolution of frequencies, and frequency maximums. One result of this project will be an interface for analyzing and comparing GWs from data obtained from future simulations.

When LIGO first discovered GWs last year, it once again validated Einstein's theory of general relativity. It also opened up a whole new technique for observing the universe capable of probing astronomical objects previously out of reach such as the core of a supernova. GWs are arguably one of the most important scientific discoveries of the decade. This Matlab interface makes it easier to analyze waveforms and share the results with facilities like LIGO, so that they may one day detect GWs from CCSNe."

SII - 12 Maria McQuillan, University of Saint Thomas, *Methods on Efficiently Relating Data from the Sun to In-situ Data at L1: An Application to the Slow Solar Wind*
Understanding space weather has become increasingly important as science extends its reach into the universe. The solar wind is highly ionized plasma that causes compression and relaxation in our magnetosphere, and affects spacecraft and astronauts in outer space. There are two types of solar wind, fast and slow wind. The fast wind is considered to be steady in composition and speed. The slow solar wind is known for being variable in composition and speed. Fast solar wind originates from coronal hole regions on the sun, while the slow solar wind's origin is very controversial. There are currently two types of theories for slow solar wind. One theory involves wave heating dynamics, while the other contends that slow wind originates from magnetic reconnection that opens magnetic field lines. These models are currently under-constrained with both types able to reproduce the long-term, average behavior of the wind. To further constrain these models, it was necessary to research small scale structure in the solar

wind, however analyzing these structures pushes the limits of the current instrument capabilities. We developed techniques that provide an automated process to quickly generate results from multiple different analysis techniques, allowing the user to compare data from STEREO's Heliospheric Imager (HI) and from data taken at L1. This increases the efficiency and ability to relate data from the sun in HI and data at Earth at L1. These techniques were applied to a study on the slow solar wind which lead to possible evidence for the S-Web model.

SII - 13 Elliott Capek, Oregon State University, *Using Brownian Dynamics to simulate the Dynein motor protein*
Dynein is a motor protein which uses cellular energy to carry out a variety of force-requiring functions within the cell, such as moving biomolecules and beating cilia. Dynein is different from other motors in that it has a large distribution of step sizes and can even take backwards steps. Our project seeks to test a current hypothesis on how Dynein generates motion by modeling it as a rigid hinged system feeling spring forces. We capture Dynein's "powerstroke" by transitioning our model between different spring force states. We then simulate this model using Brownian dynamics to recreate experimental data.

SII - 14 Collin Wilkinson, Coe College, *A Novel Proton Imager*
In recent years, proton therapy has achieved remarkable precision in dose delivery to cancerous cells while avoiding healthy tissue. Howeverto utilize this high precision treatment a greater accuracy in positioning the patient is needed. A 3% range of uncertainty exists in the current practice of proton therapy due to the conversion of units for x-rays to stopping power. This study focuses on the use of protons instead which would eliminate this conversion entirely, determine a more accurate stopping power.

There have been two separate detectors designed with unique glasses. The first detector design utilizes the scintillating high density glass barsthe other semiconducting glass fibers. The unique geometry of these detectors allows for the measurement of both the position and residual energy of pencil beams of protons eliminating the need for trackers in the system. The simplicity compactness, and efficiency was the major objectives in these models for the purpose of presenting a novel imaging technique that is both precise and practical for a clinical setting. The same devices can also be suitable to detect the prompt gammas (2-15 MeV) for in vivo tracking of the Bragg peaks.

This report summarizes the optical and electrical detector designsresolution of the imager data collection and the image reconstruction methods as well as the properties of the materials specifically developed for these systems. Preliminary images created via Geant4 simulations, and the approaches using prompt gammas during the proton therapy will be reported."

SII - 15 Luciano Manfredi, Loyola Marymount University, *Horizon Quantum Mechanics of Sub-Planckian GUP Black Holes*
We study the Horizon Wave-Function (HWF) description of a Generalized Uncertainty Principle inspired metric that admits Sub-Planckian Black Holes, where the black hole mass m is replaced by the modified GUP Mass M=m(1+β/2 (m_p^2)/m^2). Considering the case of a wave-packet shaped by a Gaussian distribution, we compute the HWF and the probability that the source is a (quantum) black hole, i.e. that it lies within its horizon radius. The case $\beta < 0$ is qualitatively similar to the standard Schwarzschild case, and the general shape of the probability is maintained when decreasing the free parameter, but shifted to reduce the probability for the particle to be a black hole accordingly. The probability grows with increasing mass slowly for more negative β, and drops to 0 for a minimum mass value. The scenario differs in significantly for increasing $\beta > 0$, where a minimum in the probability is encountered, thus meaning that every particle has some probability of decaying to a black hole. Furthermore, for sufficiently large β we find that every particle is a quantum black hole, in agreement with the intuitive effect of increasing the free-parameter, which creates larger mass and horizon radius terms. This is likely due to a "dimensional reduction" feature of the model, where the black hole characteristics for sub-Planckian black holes mimic those in (1+1)-Dimensions and the horizon size grows as mass inverse. The probabilities are truncated at a threshold mass that defines a minimum value of the horizon.

SII - 16 Zackary Hutchens, High Point University, *The Impact of Studio Mode on Conceptual Understanding and Physics Identity Development*
Studio physics is an innovative pedagogy which uses interactive-engagement to teach introductory physics. Over a span of four semesters at Texas A&M University-Commerce, data was collected in both traditional and studio physics courses using the BEMA and FMCE concept inventories and the CUPID physics identity survey. The results demonstrate that studio mode is a highly effective method of teaching calculus-based physics, with 24.06 and 19.64 percent higher mean normalized gain for PHYS 2425 and PHYS 2426 respectively. The results of CUPID show that studio mode generates some improvement in physics identities for first-semester physics, but show no significant change in second-semester physics.

SII - 17 Paula Rodriguez, University of Maryland, *The Effect of Nanotextures on Collective Cell Migration of Dictyostelium Discoideum*
Cell migration is a mechanism by which cells move from one site to another. Cells migrate to accomplish different tasks during their lives such as wound healing immune responses, and cancer metastasis. Chemotaxis causes actin polymerization when cells move along chemical gradients (Iglesias & Devreotes, 2011). Dictyostelium discoideum cells area a type of amoeba that provide a model to study cell biochemical signaling and collective cell migration (Franca-Koh et al., 2006; Annesley and Fisher, 2009; Weijer, 2009) as they rely on chemotaxis to find nutrients when starved. Chemotactic signaling can be modeled as a reaction-diffusion system where cells migrate upon activation of a biochemical gradient. Excitability is exhibited with waves of cAMP (cyclic Adenine Mono Phosphate) while aggregating (Levine &Reylnolds, 1990.)

Dictyostelium disodium (Dicty) cells were imaged using bright field microscopy and presented successful streaming features. With image analysis and particle tracking algorithms/toolsit can be determined whether important differences appear during the streaming process on different nanotextures. Furthermore the Mean Square Displacement (MSD) gives a measure of the probability density of a 2-D particle. This model is to be used to analyze the particle behavior of Dicty cells in different nanotextures which will ultimately compare the migratory behavior of individual cells (McCann et al. 2010.) in different surface textures."

SII - 18 Brandon Inscoe, High Point University, *Testing and Modeling a Physical Galton Board*
In this project we created a computational model of a Galton board where the ball's path is determined by physical collisions with each peg and by actual physical parameters of the ball, pegs, and board. To test the model, we built a Galton board and compared results with the computational model. The computational model is similar enough to the actual board that the model can be used to investigate how the statistical distribution of the ball depends on various parameters of the ball and board. The Galton board is a useful educational instrument to teach statistics and classical physics. It is also a useful device for demonstrating DC resistive circuits by analogy.

SII - 19 Michael Welter, High Point University, *Creating Physics Simulations with VPython and PyODE*
The open dynamics engine (ODE) is an open source, high-performance library for simulating rigid body dynamics. It has

advanced joint types and integrated collision detection with friction. PyODE is a set of open source bindings that provides an API in Python for ODE. In this project we combined VPython and PyODE, taking advantage of VPython for simple yet rich graphics capabilities and ODE for dynamics computation. We will present results of simple tests of the validity of the ODE and will provide examples of how it can be used for simulations in classical mechanics and thermodynamics.

SII - 20 Keisha Daughtry, High Point University, *Aerodynamic Characteristics of Modern Upper-Level Competition Soccer Balls*
With each FIFA World Cup, a new soccer ball design is produced. Every four years, manufacturers utilize technological advancements to produce a product that satisfies the demand of athletes. Soccer ball construction has significantly changed over the years since 1930 where the first 32-panel non-textured surface World Cup ball was introduced to the most recent 2014 design which consists of 6 panels and a rough surface texture. Despite the significance of this important competition, no studies have been conducted to observe the aerodynamic properties of the 2014 FIFA-approved Brazuca match ball. Therefore, the primary goal of this study was to investigate how the aerodynamic properties of the Brazuca ball compare to traditional 32-panel soccer balls. Five different soccer balls were launched and their flight paths recorded from two separate angles. Using Tracker Video Analysis and a Python computer program, flight data including lift and drag coefficients were obtained. By studying the external characteristics of panel numbering, surface texture and bonding method, we found that among all the investigated balls the official match ball had both the lowest drag coefficient and highest magnus coefficient.

SII - 21 Michael Wall, Texas Lutheran University, *CO2 Retention in Sodium and Potassium Germanate Glasses*
Alkali germanate glasses are little studied at high alkali content. We found that lithium germanates (RLi2O*GeO2) do not make glass above R = 1.0. While analyzing the phase diagrams, we found that sodium and potassium germanates (RM2O*GeO2 M = Na, K) had better opportunities of making glass. For potassium, a eutectic appeared in the phase diagrams near R = 0.74 and clear glass was formed. We increased R to 0.9 and then continued to increase R by increments of 0.2 until R = 2.3. All compositions formed glass. As R increased above 1.1, we discovered there was CO2 retention in the sample, since the predicted weight loss was larger than the actual weight loss. For sodium, a eutectic appeared around R = 0.7. We increased R to 1.0 and then continued to increase R by increments of 0.3 until R = 4.0. We observed CO2 retention in all the sodium and potassium germanate samples using Raman spectroscopy and noticed that as R increases, so did the narrow (CO3)-2 peak between 1050 cm-1 and 1080 cm-1. To test if the atmosphere was affecting the retention, we ran Raman on "fresh" samples. Spectroscopy was run on different R values after roller quenching, then exposed to air for successive 10 minute intervals and spectra were reacquired for the glasses. We observed an increase in the vibrational signal of (CO3)-2 in the sample. Also, these spectra include features representing the Q units at each glass composition.

SII - 22 Amiras Simeonides, High Point University, *Construction and Testing of a TIRF-FCS Microscope*
This project focuses on the construction of a Total Internal Reflection Fluorescence Correlation Spectroscopy (TIRF-FCS) apparatus. This apparatus uses a high-power laser to create a very small excitation field that will create bursts of light as fluorescent-labelled molecules travel through it. In addition to the process of aligning the laser using mirrors and lenses, a Single Photon Counting Module (SPCM) was aligned to detect output fluorescence. A LabVIEW program was written to collect data from the SPCM using a Data Acquisition (DAQ) card, interface the DAQ to a PC to adjust parameters such as sampling rate and number of samples collected, and display and save the data to the PC. FCS uses a statistical technique called autocorrelation to analyze the bursts of light collected by the DAQ into data like molecule mobility and concentration. A Python program was written to display the photon count data and perform a multiple-tau autocorrelation, then save the autocorrelated data. This data was then fitted with an autocorrelation curve using a program called PyCorrFit to determine parameters such as average particle brightness and time of diffusion.

SII - 23 Louis Varriano, University of Tennessee, Knoxville, *Neutron-mirror neutron oscillations in a residual gas environment*
Both mirror matter, a candidate for dark matter, and ordinary matter can have similar properties and self-interactions but will interact only gravitationally with each other, in accordance with observational evidence of dark matter. Although mirror matter does not couple to ordinary matter by Standard Model interactions, some additional interactions might exist, providing small mixing of ordinary matter neutral states, like the neutron, with mirror components. Three separate experiments have been performed in the last decade to detect the possibility of neutron-mirror neutron oscillations. In the analysis of the data of these experiments, the effect of the presence of residual gas (due to an imperfect vacuum) was not considered. This work provides a formalism for understanding the interaction of the residual gas in experiments with ultra-cold neutrons. This residual gas effect that was previously considered as negligible has an impact on the probability of neutron to mirror neutron transformation. This formalism is used to evaluate the three previous experiments and provide a small correction to these experiments. The density matrix formalism also provides a framework for the future mirror matter search experiments and can be used to evaluate experiments for effects from the presence of mirror matter and from a mirror magnetic field, which have not been considered before. Furthermore, the formalism is applied to neutron-antineutron oscillations for potential future experiments.

SII - 24 Quinn Pratt, University of San Diego, *Experimental Plasma Physics - Emissive Probe*
Theory, design, and operation of an emissive probe for low temperature laboratory plasmas is discussed. The probe is used to measure plasma potentials in the sheath region for research in boundary layer dynamics. This type of fundamental plasma research is crucial for understanding plasma-material interactions and moving toward a more cohesive model for sheaths. Theory of the probe's interaction with the plasma and methods for interpretation of the characteristic curves is presented. Furthermore, velocimetry considerations using Laser Induced Fluorescence (LIF) are discussed. Emissive probe, as well as preliminary velocimetry results are shown.

SII - 25 Clifford Pack, Texas Lutheran University, *Understanding simulations and uncertainties in theoretical particle physics*
In this paper we will discuss one of the current methods of estimating theoretical uncertainty in a Monte Carlo based particle event simulations, being run in the event generator GENEVA, as well as presenting an alternative method that takes advantage of direct QFT calculations which in turn should reduce a portion of the uncertainty. Consequently, an overview of jets and the observable tau (τ_2) will be used as an introduction to the current method being used as well as its applications to the new method. The effectiveness of the method was reassured by testing the convergence of each consecutive higher order term of the QFT series. The new method we have tested was successful, though further examinations on how modifications can be made to reduce error further, while continuing to be confident in its reliability, are being made.

SII - 26 Angel Gutarra-leon, George Mason University, *Experiments on Levitation with the Electrodynamic Wheel*
Our experiments explored inductive magnetic levitation (MagLev) and the possibility of using simple permanent magnets and conductive tracks instead of coils for MagLev applications. Our

investigations used a circular Halbach array with the strong variable magnetic field on the outer rim of the ring. Such a system is usually called an Electrodynamic Wheel (EDW). Rotating this wheel around a horizontal axis above a flat conducting surface should induce eddy currents in said surface through the variable magnetic flux. The eddy currents produce, in turn, their own magnetic fields which interact with the magnets of the EDW. We constructed a four inch diameter Electrodynamic Wheel using twelve Neodymium permanent magnets and demonstrated that the magnetic interactions produce both lift and drag forces on the EDW which can be used for levitation and propulsion of the EDW. The focus of our experiments is the direct measurement of lift and drag forces to compare with theoretical models to demonstrate magnetic levitation without the need for coils and complex control circuitry.

SII - 27 Maegan Idrogo, Texas Lutheran University, *Synthesis and Characterization of Intermetallic Compounds in RE3TX5: Ce3ZrSb5, Pr3TiSb5, Ce3TiSb5*
Synthesized from Sn flux growths and arc melting, Ce3ZrSb5, Pr3TiSb5, and Ce3TiSb5 samples were created in both single crystal and poly crystal form. By synthesizing and characterizing these complex intermetallic compounds, our group anticipates understanding these known and unknown materials and their physical properties in hopes to help with the advancement of new materials. In our experimentation, we worked with compounds in the form of RE3TX5 after previous work with flux growth Ce3TiSb5 showed interesting properties. We synthesized both Ce3ZrSb5 and Pr3TiSb5 using Sn flux growths, creating single crystals that were characterized through powdered x-ray diffraction (XRD). Both of these crystals had data showing peaks that matched up with their respective elements, ensuring that their make-up was what we expected it to be. Our future work with these crystals includes magnetic susceptibility and specific heat measurements to learn about their magnetic properties and possible superconductive behavior. Our arc-melted sample, contrarily, didn't show as promising results. Data for Ce3TiSb5 revealed only Ce and Sb in our metal, leading us to conclude that the Ti didn't react during the arc-melting process. Future work for this sample would require recreating this sample with a higher power level during arc melting.

SII - 28 Tommie Day, St. Mary's College Of Maryland, *Computing particle interaction rates near black holes*
Particle physics seeks to understand the behavior of the smallest particles in our universe. I am particularly interested in the behavior of these particles in regions where spacetime is severely warped by massive objects. To get information about any kind of particle interaction, you must describe it mathematically using the matrix element. This matrix describes the transformation between the initial and final states in an interaction. It can also be used to get information about the probability that interactions will happen. But when dealing with massive objects, we must also take general relativity and the spacetime metric into account. My research focuses on developing a computer program which can compute particle interaction rates near black holes, and potentially other very massive objects.

SII - 29 Prabhakar Misra, Howard University, *REU Site in Physics at Howard University*
The NSF-funded Research Experiences for Undergraduates (REU) Site in Physics at Howard University offers physics research opportunities with a special focus on students from minority institutions and those with limited STEM research resources. The research projects were designed to develop and nurture skills in computational and experimental condensed matter physics at the nanoscale, materials physics, string theory, atmospheric physics, optics and laser spectroscopy. Each student was matched with a research mentor prior to the immersion, based on their academic background and research interests, and subsequently the students were engaged in tailored projects designed to increase their confidence and independence. The students made a mid-term and final research presentation during the ten-week period and wrote a final paper in refereed journal format. The REU immersion helped expose students to cutting-edge research methods in physics; it also helped them to develop an awareness of applications for STEM-related research careers and fostered lasting relationships between the participants following the REU experience.

Financial support from the National Science Foundation (Award PHY-1358727) is gratefully acknowledged."

SII - 30 Shannon Armstrong, Grove City College, *Differences in students' treatment of forces on solid and liquid objects*
Many introductory physics classes introduce the concept of pressure by discussing the forces acting in a fluid. In order to accurately analyze these forces, students need to be able to treat a section of a fluid as an object and identify the forces acting on that object in the same way they would for a solid object. We do not know of any research that investigates student abilities to complete this task. We developed a question requiring students to compare forces acting on a solid object and an object made of a liquid. This question was given to students in a calculus-based introductory class, after a lecture introduction to pressure but before completing all instruction on fluids. This poster discusses the results from this question, which show that a significant portion of students do not treat the liquid object the same way that they would treat a solid object.

SII - 31 Evan Peters, Oregon State University, *Data Driven Study of Neutron Response Using Quasielastic Neutrino Scattering in the Minerva Experiment*
Understanding how particles behave in detectors is a critical part of analyzing data from neutrino experiments, but neutral particles are difficult to characterize. The purpose of this project was to calibrate the neutron response in Quasielastic antineutrino scattering (QE) events in the Minerva detector. We applied quasi-elastic assumptions to estimate the outgoing neutron kinematics in QE scattering, and then added modifications to improve the model's predictions for neutron response in data. We compared these kinematic predictions of neutron energy and angle to Monte Carlo simulations of QE scattering and to the behavior of reconstructed energy "blobs" that characterize neutral particle behavior in simulated and real Minerva data. Filtering events for neutron energy, angle, and distance from the interaction vertex, we derive calibration functions for both the simulation and real data. Future work will include potential changes to the blobbing algorithms and refinement of the calibration technique using rigorous statistical methods.

SII - 32 Shannon Dwyer, North Carolina State University, *Misbehaving Materials: A computational investigation of rare-earth tritellurides and the charge density wave phase transition*
Charge density waves (CDWs) are a class of emergent phases in solid state materials, characterized by a periodic distortion of the electronic charge density distribution. Experiments involving temperature and pressure modulation have demonstrated that the rare-earth tritelluride crystalline solids exhibit the charge density wave phase. Although current theory predicts a mechanism for the formation of this phase, it does not accurately correspond to the experiments in these materials. To address this inconsistency, we have simulated pressure modulated in the unit cell with respect to the a-, b-, and c-lattice constants using density functional theory (DFT) calculations based on these changing parameters. Looking into bandstructure, density of states, charge transfer, and Fermi surfaces of these materials, we have developed an enhanced understanding of the atomic contributions to emergent electronic configurations, especially with respect to the CDW phase transition.

SII - 33 Liam Shaughnessy, University of Maryland, College Park, *Exploring the Suitability of the Quake-Catcher Network in the USGS ShakeMap*

Following the September 3, 2010 Darfield, New Zealand earthquake, the Quake-Catcher Network team rapidly deployed ~200 low-cost seismic sensors around Christchurch. Previous tests of these CodeMercinaries JoyWarrior JWF14F8 14-bit, three-component, Class C accelerometers suggest that the data collected is potentially useful for ground-motion studies, which could include the USGS ShakeMap program [Evans et al., 2014]. The purpose of this study is to conduct a feasibility test to show if aftershock data collected by QCN sensors deployed in the epicentral region of the 2010-2011 Darfield and Christchurchs earthquakes are suitable for integration into the USGS ShakeMap software and produce useful results. We compare our residual between our ground-motion results with distance as compared to the Bradley [2013] ground-motion prediction equations for both QCN and traditional GeoNet strong motion data. We examined ShakeMaps comprised of QCN and GeoNet data individually and combined, and investigate the ground-motion residuals between the maps for sake of comparison. We concluded that QCN accelerometers provide a cost-efficient method to obtain accurate ground-motion data for use in ShakeMaps. In areas of low station density, where traditional networks are limited, QCN sensors can increase local station density and provide higher resolution mapping of ground-motion across urban areas that may help to inform earthquake response.

SII - 34 Valerie Becker, Southern Illinois University Edwardsville, *HST STIS Observations of Interstellar Chlorine*

Among the dominant ions of abundant elements in the diffuse interstellar medium, only chlorine (Cl II) has a rapid exothermic reaction with molecular hydrogen (H_2) that should lead to the dominance of its atomic form (Cl I) in clouds where most of the hydrogen is in H_2. We present an archival study of the interstellar Cl I λ1347.24 absorption observed at high spectral resolution toward 41 stars with the Space Telescope Imaging Spectrograph (STIS) onboard the Hubble Space Telescope (HST). We explore the relationship between interstellar N(Cl I) and N(H_2) with a larger sample and a larger N(H_2) range than the Copernicus interstellar survey of Moomey et al. (2012). We additionally contrast it with the high-z QSO damped Lyman-alpha system (DLA) findings of Balashev et al. (2015). We find that for log N(H_2) > 19.0, the HST STIS sample is consistent with the Copernicus data and high-z DLA samples in indicating a linear trend of increasing N(Cl I) with increasing N(H_2). Furthermore, all of the interstellar sightlines with log f(H_2) > -0.5 have log N(Cl I) > 13.5, and those with log f(H_2) < -1.5 have log N(Cl I) < 13.5, where f(H_2)=2N(H_2)/[2N(H_2)+N(H I)] is the fractional amount of H_2 in H. Observations of interstellar Cl I can potentially trace the H_2 fraction of the "CO-dark" gas marking the transition between diffuse atomic and dense CO molecular clouds.

SII - 35 Rachael Huxford, Towson University, *Roadrunner Physics: using cartoons to challenge student preconceptions*

The cartoon universe is governed by laws that differ radically from those in the real world, but also mirror some of our preconceptions of how the world "should" work. We all know that Wile E. Coyote will never be able to catch the Roadrunner with a fan attached to a sailboard, or an outboard motor submerged in a pail of water—but why, exactly? We have designed some classroom demonstrations accompanied by personal-response-type questions that use classic cartoon clips to challenge student thinking in introductory courses, prompting them to rediscover the truths of physics for themselves. We extend this idea to intermediate-level modern physics, showing that some phenomena in the cartoon universe can be reconciled with standard physics if the values of fundamental constants such as c, G and h differ radically from those in the real world.

SII - 36 Javier Gil, Valencia College, *Modern Version of Thompson's Electron Charge to Mass Ratio Experiment in an Introductory College Physics Lab*

In 1897 J.J. Thomson has discovered the electron by investigating the behavior of cathode rays in electric and magnetic fields. He was able to establish that current carrying particles have a negative charge and measured their charge to mass ratio.

I have set up a modern version of Thompson's famous experiment in an introductory physics lab at Valencia Collegeusing a cathode tube (Thomson Tube S 1000617) obtained from the 3B Scientific. The apparatus allowed me to observe deflection of electron's beam and to measure e/m ratio with a percent error of 2.706%. I will present the details of the experimental setup the data obtained and discuss possible improvement to the experiment and how it fits in an Introductory Physics Laboratory."

SII - 37 Frank McKay, University of Washington, *Obtaining Scalable and Uniform Growth of WSe2*

On this poster I present the method I used to obtain scalable and uniform growth of crystals of WSe_2 by CVD. My poster illustrates the reasons for the growth of these crystals and what they can be used for. The poster also mentions my further work in fine tuning the growth of these crystals.

SII - 38 Joshua Carr, Roanoke College, *Temperature Dependence of Vibrational Modes in Two-Dimensional Transition Metal Dichalcogenides*

Two-dimensional (2D) materials such as graphene and molybdenum disulfide (MoS_2) hold great promise as a novel platform for nanoscale electronic devices and as a possible solution for heat dissipation in integrated circuits. Here we focus on a specific subset of 2D materials called transition metal dichalcogenides (TMDs). We use temperature-dependent Raman spectroscopy to characterize thermal properties of a few TMDs. Specifically, we measure how the Raman resonant peaks corresponding to the different lattice vibrational modes vary with temperature, including peak shift, linewidth shift, and changes in intensity. These data will be compared to theoretical models of phonon-phonon interactions and used to understand how these changes are related to thermal properties of TMDs.

SII - 39 William Myers, Cleveland State University, *Elimination of Acoustical Noise for STM Examination of Organic Molecule Crystallization on Surface Reconstructions*

Organic electronics are used in traditional solar cells and also in flexible electronics. Unfortunately, the conductivities of organic semiconductors are significantly lower than their inorganic counterparts. This project examines crystallization by directed self-assembly of the organic molecules via a surface reconstruction as a method to increase conductivity. The crystallization is characterized by Scanning Tunneling Microscopy (STM). In order to achieve optimal STM images, this work examined: (1) etching sharp STM tips, (2) achieving large terraces of reconstructed Si and Au surfaces, and (3) noise isolation. We determined optimal PtIr tip etching procedures, demonstrating that an alternating current of 40V in a 1M $CaCl_2$ solution results in a tip with an ~ 13μm radius of curvature, comparable to other PtIr tips found in literature. Further, we demonstrated the ability to produce flat terraces on both the Si and Au surfaces. Finally, the STM is housed in a glovebox to keep the surface reconstructions and organic molecules from degrading. However, acoustical noise limits the ability to achieve atomic resolution. Introducing a foam-lined acoustical shell around the microscope significantly reduced acoustic noise and atomic resolution is achieved. Also, we demonstrate that acoustic noise, while it reduces the resolution, does not appear in the tunneling current.

SII - 40 Trevor Olsson, The University of West Florida, *LIBS of LIB: Lithium Identification of Batteries Using LIBS*
In our experiment, we have explored properties of a Lithium Cobalt Oxide sample with Laser-Induced Breakdown Spectroscopy (LIBS). This exploration has lead us to develop an efficient LIBS system able to record emission spectra of laser induced plasma flumes. Through the analysis of these flumes, we have quantified the Stark-effects (Stark shift, Stark broadening) as well as observed reabsorption. The signature of reabsorption is a specific dip at the peak of an emission line. Reabsorption can help to identify electronic transitions of elements linked to the ground electronic state of the atoms. We have also observed the emission from elements other than Lithium that are present in the sample, such as Cobalt, Oxygen, and Carbon.

SII - 41 Brianna Kenney, Alabama A&M University, *Study of Defects in Strontium Titanate Using Electron Paramagnetic Resonance Spectroscopy*
Strontium titanate is a material of considerable interest for electronic applications. A recent study revealed that strontium titanate (STO) annealed in strontium oxide (SrO) powder exhibits large persistent photoconductivity (PPC) after exposed to sub-bandgap light of 2.9 eV or higher. To better understand this phenomenon a titanium dioxide (TiO_2) annealing treatment was applied to STO substrate to see if this property would be exhibited under altered conditions. Using electron paramagnetic resonance (EPR) spectroscopy, we were able to detect Fe^{3+} and Cr^{3+} defects in as-received STO samples. After annealing the samples, Fe^{3+} defects were not detected in both the SrO and TiO_2 annealed; moreover, the signal intensity of Cr^{3+} defect decreased by no more than 20% for both annealed samples. To further study the samples we applied light illumination also referred to as photo-EPR by using LEDs and laser diodes that ranged from 1550 to 397 nm. Similar behavior was seen in both the SrO and TiO_2 annealed samples in which the Cr^{3+} signal intensity reduced by at least two orders of magnitude; however, the TiO_2 annealed sample did not exhibit this "giant" PPC. These results imply that Cr^{3+} is not responsible for this novel property. Ongoing studies are necessary to better understand what defect is responsible for this significant change in the electronic properties of STO.

SII - 42 Lamario Williams, University of Alabama at Birmingham, *Statistical Analysis of the differences between fibroblasts and mesenchymal stem cells*
Stromal cells surround and support parenchymal cells (functional cells) in organ tissues. Some types of stromal cells include fibroblasts, pericytes, and mesenchymal stem cells (MSCs). It is known that stromal cells contribute to tissue repair, immunosuppression, and tumor survival. Better understanding of their gene expression can provide insight into developing therapies. Knowing the differentially expressed genes and associated pathways will help in identifying similarities and differences in MSCs and fibroblasts. The analysis was carried out on a public dataset first used in a 2015 study (Danieli P., et al). Human MSCs from adult bone-marrow and dermal fibroblasts underwent high-throughput transcriptional profiling. The 2015 study aimed to identify the paracrine effects of these different cell types in myocardial stroma. Differential expression analysis is performed using the Significance Analysis of Microarrays (SAM) package on R software to further analyze differences in these cell types. Pathway enrichment was done with MSigDB, which will shed light on core functional differences between fibroblasts and MSCs. Future goals are to characterize the differences between MSCs and fibroblasts with wet lab techniques. Currently it appears that MSCs have the potential for substantial therapeutic opportunities. If fibroblasts have similar features, this could open the door for accessing a far more easily obtainable therapeutic cell source, as well as shedding light on relevant immune-related and tissue repair aspects of these cell types.

SII - 43 Brandon Barker, University of Tennessee, Knoxville, *Discontinuous Galerkin Methods in Context of Nuclear Astrophysical Simulations*
A problem of high importance in computational astrophysics is obtaining accurate solutions to the Euler equations of hydrodynamics. We are interested in solving the Euler equations in the context of core collapse supernovae. As many of the critical processes of core collapse supernovae are hydrodynamical in nature, it is imperative that these equations be solved as accurately as possible in order to yield reliable results. Most current solutions to the Euler equations employ finite volume methods. These methods involve breaking up the computational domain into grid cels and computing a cell average of the solution over each cell. One of the drawbacks of finite volume methods is that higher order methods require larger computational stencils. We explore the use of Discontinuous Galerkin (DG) methods in solving the Euler equations in context of core collapse supernovae. In particular, we are interested in using DG methods to solve the Euler equations for a general nuclear equation of state. Discontinuous Galerkin methods have the advantage that higher order schemes do not require larger stencils. We aim to construct methods which preserve positivity in pressure and density. We present our solution method and results from solving Riemann problems with a non ideal equation of state.

SII - 44 David Goodloe, Birmingham-Southern College, *Analysis of Boron Atom Incorporation in Boron-Doped Nanostructured Diamond Films Using X-Ray Photoelectron Spectroscopy*
It is well established that boron doping of nanostructured diamond (NSD) films increases conductivity. While natural or synthetic diamonds are electrically insulating, boron-doped diamond or NSD films are p-type semiconductors with numerous applications because of diamond's other advantageous material properties. However, the location and mechanism of boron atom incorporation in doped diamond films has not been discovered, and optimization of boron-doped diamond applications is thus limited. In seeking an explanation for doping activity, NSD films were chemical vapor deposited onto Ti-6Al-4V substrates. Samples were prepared using gas flow-rates of 500 sccm H_2, 88 sccm CH_4, and 8.8 sccm N_2, and diborane (B_2H_6) gas flow-rates between 0.1 and 0.3 sccm. The project targeted nitrogen as the mechanism of boron incorporation, and four conditions were tested: low diborane with nitrogen, high diborane with nitrogen, low diborane without nitrogen, and high diborane without nitrogen. X-Ray Photoelectron Spectroscopy (XPS) surface analysis was utilized to detect specific binding energy chemical fingerprints, with high-resolution focus on the C1s and B1s regions. Curve fitting analysis of high resolution XPS spectra revealed relative intensities of various chemical bonds that indicated a strong correlation between boron and nitrogen incorporation in the form of boron-nitride (BN). Without nitrogen, boron did not bind substitutionally with carbon, indicating that nitrogen acts as a vehicle for boron incorporation into the diamond lattice.

SII - 45 Dagan Hathaway, University of Wisconsin - River Falls, *A Study of Quantum Optics*
Pairs of single photons produced by spontaneous parametric down conversion were used to explore the wave-particle duality of light and perform the which-way experiment. The tests showed that single photons are capable of being both like a wave and a particle depending on how one chooses to measure them. The test used for the wave-like nature of light used a Mach-Zehnder interferometer, which was also used in the which-way experiment, and gave a fringe visibility of ~0.25 with single photons. The which-way experiment results followed those expected by the quantum mechanics explanation of the phenomena.

SII - 46 Patrick Carroll, Miami University, *Magnetic and magnetocaloric properties of Mn5−xCoxGe3 compounds*
Mn5Ge3 exhibits a Curie temperature of 296 K and has been reported to have a magnetic entropy change comparable to that of pure Gd, which makes it a potential candidate for near room temperature magnetic refrigeration applications. In this study we have synthesized and characterized a series of Mn5−xCoxGe3compounds where x=0, 0.05, 0.1, and 0.15. The goal is to determine the effect of Co substitution for Mn on the magnetic and magnetocaloric properties of the materials. X-ray diffraction measurements revealed that all samples exhibit the D8 hexagonal structure at room temperature. Magnetization measurements show that all compounds exhibit ferromagnetism, with a decrease of Curie temperature with increasing Co concentration. Although, the magnetic entropy changes stays nearly constant across all values of x, Co substitution significantly enhances the refrigeration capacity of the materials. The largest magnetocaloric effect is observed in the Mn4.95Co0.15Ge3 compound with a peak magnetic entropy change of 7.75 J/kg K and a peak refrigeration capacity of 380.32 J/kg for a magnetic field change of 5T. The results provide further understanding of potential magnetocaloric applications for this series of compounds.

SII - 47 Kelsey Kolell, University of Wisconsin- River Falls, *Simulating Atmospheric Profile and Particle Interactions at the University of Wisconsin-River Falls*
We created an atmosphere of different layers (called an atmospheric profile) at the University of Wisconsin-River Falls. To do this we collected data from GDAS which is a data base full of weather information. We used data for the first two weeks in July. From there we started to simulate particle interactions. We put the atmospheric profile into FLUKAa program that will simulate these interactions. FLUKA created a beam of particles and projected them at a location we desired. This gave us an output file with information about howcmany particles interacted through this specific atmosphere."

SII - 48 Laura Lusardi, University Of Wisconsin River Falls, *Observation of the Cosmic-Ray Shadows of the Sun and Moon with IceCube*
We report on a study of the effects of the moon and sun on the event rate within the IceCube detector. IceCube is a neutrino telescope constructed deep within the Antarctic ice. The detector utilizes 5,160 light sensors deployed in a cubic-kilometer of ice at the South Pole to record the light produced by relativistic, charged particles produced by cosmic ray and neutrino interactions. IceCube's main goal is to detect high-energy extraterrestrial neutrinos originating from sources such as active galactic nuclei, gamma ray bursts, and supernovae. In this study, we used a binned one-dimensional analysis to determine the most likely location of the sun and the moon by treating them as cosmic-ray sinks and comparing the number of events coming from their directions to the surrounding sky. Then we conducted an unbinned two-dimensional analysis using a maximum likelihood algorithm to determine the shadow centers, which are compared to the known locations of the sun and moon. Monitoring both of these celestial bodies' cosmic ray shadows serves as an important tool for the detector's angular calibration. Our unbinned one-dimensional analysis showed a consistent stable angular resolution over the past five years, while demonstrating systematic differences each year for the sun shadow. These shadows may provide new insight into cosmic phenomena by measuring the consistency of the moon shadow, fluctuations in the sun shadow, and number of cosmic rays reaching the detector. These studies may hold important implications for the future of the detector, as well as potential applications for solar physics.

SII - 49 Justin Flaherty, Cleveland State University, *Stochastic Modeling of an Optically Trapped Cilium*
We explore, analytically and experimentally, the stochastic dynamics of a biologically significant slender microcantilever, the primary cilium, held within an optical trap. Primary cilia are cellular organelles, present on most vertebrate cells, hypothesized to function as a fluid flow sensor. The mechanical properties of a cilium remain incompletely measured. Optical trapping is an ideal method to probe the mechanical response of a cilium due to the spatial localization and non-contact nature of the applied force. However, analysis of an optically trapped cilium is complicated both by the geometry of a cilium (a slender deformable cylinder oriented along the optical axis) and boundary conditions (the cilium is anchored, not free to diffuse). Here, we present experimentally measured mean-squared displacement data of trapped cilia where the trapping force is oppositely directed to the elastic restoring force of the ciliary axoneme, analytical modeling results deriving the mean-squared displacement of a trapped cilium using the Langevin approach, and apply our analytical results to the experimental data. We demonstrate that mechanical properties of the cilium can be accurately determined and efficiently extracted from the data using our model. It is hoped that improved measurements will result in deeper understanding of the biological function of cellular flow sensing by this organelle.

SII - 50 David Smith, University of West Florida, *Evaluating Meteorological Models at the Surface*
Volatile organic compounds (VOCs) emitted into the atmosphere can be traced back to their source through the use of meteorological models, such as the NOAA HYSPLIT model. However, under certain conditions, for example at the surface, the models ability to accurately predict trajectories decreases, therefore other methods are required to correct for the discrepancies. A good illustration of this is the Santa Barbara channel, in which five whole air samples were collected during the 2016 NASA Student Airborne Research Program (SARP) and analyzed using gas chromatography techniques. These samples were determined to have elevated concentrations of halogenated species, known urban tracers, such as HCFC-141b (54 ± 1.6 ppt) and dichloromethane (97 ± 4.9 ppt) compared to background of 24 ppt and 31 ppt. Samples collected aboard NASA's DC-8 aircraft were used to compare samples collected at the surface. HYSPLIT models at the surface predict these air masses originated in the San Joaquin Valley. Ethyne to carbon monoxide ratios in the Santa Barbara channel were prepared to observe the relative age of the air mass and was determined to be relatively young, indicative of a nearby source. Wind readings from the Santa Barbara channel give winds coming from the southeast/south-southeast and from Los Angeles from the east. Meteorological effects due to the Catalina Eddy were also analyzed to determine the location of the source.

SII - 51 Blake Hendrix, Eastern Michigan University, *Plasma Engines*
Plasma engines are used to adjust the motion of CubeSats in space. Most propulsion scientists would agree that the use of electromagnets is the most efficient way to direct the plasma. The problem is, magnetic nozzles require more energy than CubeSats can supply in certain circumstances. A more energy efficient design could be to use mechanical nozzles or permanent magnet nozzles.

In order to compare the output thrust of mechanical nozzles versus magnetic nozzleswe have to first design an ideal mechanical nozzle. The most efficient form of mechanical nozzle is one with a converging section that flares out into a diverging section called a De Laval Nozzle. The maximum thrust in this type of nozzle is achieved when the pressure at the nozzle exit which can be controlled through lengthening and shortening the converging section, is equal to the ambient pressure around the nozzle. We have built several nozzles to determine the optimal length. Our next step will be to test the thrust from the nozzles and plot the thrust vs nozzle length to find the optimal length nozzle.

SII - 52 Abel Diaz, Rhodes College, *Determination of Ultrasonic Attenuation Parameters from Clinical Ultrasound Images*
Osteoporosis is a disease which can dramatically decrease quality of life. 10 million people in the United States currently have the condition, while another 34 million are at risk. Diagnosing osteoporosis accurately and early can lead to intervention and treatment limiting its effect on quality of life. Ultrasound can be used to determine certain properties related to bone quality and is a clinically accepted form of imaging. If these measurement correlate with bone density, the leading predictor of osteoporosis, ultrasound can be a useful diagnostic tool for osteoporosis. This study develops a method to analyze clinical ultrasound images of the hip and spine to measure ultrasonic attenuation in bone. The programming environment MatLab was used to convert image data into raw acoustic signals. LabView, a graphical programming platform, was then used to determine three frequency-dependent ultrasound parameters based on the attenuation of the signal. Ultimately, correlations of these parameters with clinical x-ray bone density measurements will potentially allow ultrasound to replace x-ray measurements for osteoporosis diagnosis.

SII - 53 Apryl Witherspoon, University of Nevada Reno, *Experimental Apparatus for Coupling Dielectric Nanospheres to Cold Atoms*
We are constructing an experiment designed to couple cold atoms to optically trapped nanospheres, in which our research team hopes to cool the nanospheres to their ground state. In this experiment, cold Rubidium atoms and optically levitated nanospheres are located in two separate vacuum chambers. The nanospheres will be coupled to the cold atoms by a one dimensional optical lattice. If successful, the cooled spheres can be used as a source for matter-wave interferometry. In the future, such matter-wave interferometry could be used for acceleration sensing, searching for Yukawa-type corrections to gravity, and for making Casimir force measurements between the spheres and a surface.

SII - 54 Nnamdi Ike, Saint Peter's University, *Self-Organization Patterns in Xenon and Krypton Cathode Boundary Layer Discharge*
Self-organized pattern formation (or self-organization) of microplasmas in Cathode Boundary Layer Discharge was first seen in high purity Xenon gas by Prof. Karl Schoenbach et al in Old Dominion University, Virginia. Our experimental group have found new modes of self-organization in Xenon by changing certain parameters in the experiment, while also observing self-organization in Krypton and potentially Argon for the first time. We have studied properties such as hysteresis, pattern formations, Nobel gas mixtures and have tried several reactor designs. In addition, we were able to observe novel structures of self-organization with these new reactor designs. Our group continues to focus on achieving sustainable self-organization in Argon, and studying the mechanics of the ring structure phenomenon.

SII - 55 Byron Fritch, University of Northern Iowa, *TiO2 Coated Nanocellulose Aerogel Catalyst*
Titanium dioxide has been shown to split water into hydrogen and oxygen gas by absorbing ultraviolet light. This ability was first discovered in 1972 by Fujishima and Honda through the use of an electrochemical cell with titanium dioxide and platinum electrodes. One way to increase the efficiency of this process is to increase the surface area of the titanium dioxide electrode. A possible solution to this problem is the use of nanocellulose aerogel coated in titanium dioxide. Nanocellulose aerogels are a light weight, high surface area material. Different coating methods were studied using titanium isopropoxide as the source for the titanium dioxide coating. The method that produced the most consistent titanium dioxide coating on the nanocellulose aerogel was a device that held the aerogel in a vapor bath for 12 hours. The nanocellulose aerogel was then removed and the water in the atmosphere reacted with the titanium isopropoxide to create the layer of titanium dioxide. Further study will be needed to determine if this material is usable in an electrochemical cell similar to Fujishima and Honda.

SII - 56 Michael Sanchez, Florida Polytechnic University, *Health Informatics with Pulse Oximetry*
Abstract - In recent years, there have been many efforts to alleviate the rising cost of health care in the United States. The price of medical sensors today is one of the highest contributors to that cost according to Patton 2015. This is in part due to the artificial scarcity of those sensors created by vendors who want to safeguard their technologies and obtain an edge on the market. In this paper we propose to recreate a specific medical sensor, called pulse oximeter, using simple components and open source programs. In the first sections, we described its general layout and explored its mechanics. We also report a small analysis of the output at the end. This sensor is a noninvasive device, designed to keep logs of the pulse and the oxygenation of blood. It can be paired with other devices such as a respiratory effort sensor and the resulting data can be used to identify any abnormalities which would lead to the detection of sleep disorders such as sleep apnea.

Patton, Mike. "U.S. Health Care Costs Rise Faster Than Inflation." Forbes. Forbes Magazine 9 June 2015. Web. 13 Sept. 2016."

SII - 57 Cailtin Kennedy, University of Wyoming, *Landing on Mars: Operations Engineering*
Preliminary Research AerodyNamic Design To Land on Mars (PRANDTL-M) is a glider with a two-foot wingspan, weighing less than twelve ounces. This lightweight efficient design gives a higher glide range, and makes it significantly less expensive to launch than conventional aircraft. The PRANDTL-M glider is being tested, redesigned, and is having scientific testing equipment installed. The added weight of the instruments compared to the original design of the vehicle led to a change in its moment of inertia, which caused instability. Several flight tests, in which the glider or its components were launched and analyzed, were conducted with variations on the dihedral and sweep angles to determine the best combination for a stable flight, as well as to ensure the functionality of the scientific equipment installed. The operations engineering position for this project focused on managing flight tests, being responsible for configuration control, and overseeing safety protocols while conducting tests. The success of this aircraft and its mission would greatly improve current knowledge about the Martian environment.

SII - 58 Connor Sampson, Roanoke College, *Modeling the effects of oscillating magnetic fields on magnetization*
It has been found that abstractions of mean field models, e.g. the Ising Model, can be computationally simulated in order to identify and observe behaviors associated with oscillating magnetic media. The purpose of this project was to analyze these types of models and apply them to study the magnetizations of a system due to periodic magnetic fields. When under the influence of an oscillating magnetic field, the magnetization of these systems tend toward an oscillatory pattern. For our experiment, we are only interested in fields that are capable of periodically driving the system between opposite states. Data was collected from a C++ program that uses a differential equation to mimic the system. The program outputs a data set which includes the overall magnetization. Then, we graph the data set to better understand the behavior of the system depending on the field that is influencing it. Currently, we can only model the system under the effect of one system at a time. We have begun to look at the system under the influence of multiple fields. This is a much more complicated process because the superposition of two fields is not necessarily additive. This will be the focus of the research moving forward.

SII - 59 James Runge, North Carolina State University, *Signal Classification from a Scintillation Detector*
I am developing algorithms to help analyze data from a scintillation detector. The raw data from the detector is a fast voltage signal which is related to the kinetic energy of the particle detected. When two particles are detected a short time apart, this voltage signal overlaps. With one signal representing two different particle energies, we lose the ability to find the energies of the individual particles. My goal is to come up with a process to run the data through that will separate out the detection events so that we can get the energy of each one.

Using R and data I generated from a CAEN DT5800D detector emulatorI have trained a neural network to recognize single vs pileup events and sort them. From this I am able to measure the energies of the single events. I am currently working on ways to deconvolute the pileup events in order to measure the energy associated with individual pulses. The method involves fitting a function(the function described by Deng et al. and can be read about at stacks.iop.org/PMB/58/7815) to the points in order to "isolate" the events. At this time I haven't completed the process, but I expect to have it working by mid-October."

SII - 60 Harrison Kesel, Ithaca College, *Comparing Laser Scanners*
For three months I have been comparing laser scanners, but have been using them for five semesters. Specifically, I've been comparing the Leica ScanStation C10 and P40. They scan and store data differently which allows for advantages in different environments. The P40 uses phase based scanning, whereas the C10 uses time of flight scanning to collect data points. It's the difference in these methods of scanning that affect the resolution, the scan distance, and the duration of the scan time. However, if the scan is taken inside, where the scan will have a short distance, then the P40 outperforms the C10 significantly. Outside where the scan distance is long, the C10 and the P40 perform equally in terms of time. It is in the initial picture quality, the distance of the scan and the resolution that set the C10 ahead of the P40.
For minimal editing, it's best to use the C10. The P40's phase based scanning method makes scanning out to far distances a difficult, multi step process. The one reason to use the P40 over the C10 outside is for high quality pictures. The P40 store the pictures as .jpeg, whereas the C10 stores pictures as a file format specific to the brand. This storage technique of the P40 allows for the user to edit pictures and enhance the quality of the color after the scan has already been taken. Overall there are many comparisons to consider when choosing which Leica ScanStation to use in a specific environment.

SII - 61 Jose Corona, Bridgewater College, *COMSOL Simulation Study of the Effect of Probe Tip Shape on the Measurement of an Electrical Field Gradient Generated by Microe*
Precision, nano-scale electric field measurements are one useful technique for characterizing nanoelectronic devices, and other nanoscaled structures and materials. The Scanning Kelvin Force Microscopy (SKFM) is one scanning probe technique utilized to measure the surface potential of a biased structure or materials with variations in work function. However, high spatial resolution measurements of electric fields that vary with location are dependent on the shape of the detecting probe tip. COMSOL Multi-Physics models were created for electrical field measurements with representative probe tip shapes and microelectronic test structures. Data demonstrated that the differential of the potential generated by small changes in tip-sample separation was more sensitive to tip shape than the potential at any given tip-sample separation. Significant decrease of change in potential across the boundary of the ground plane and biased metal line caused by averaging effect of cantilever. The width of the response could also be related to the top width of the conical probe. These results indicate that information about the electrical shape of the tip can be extracted from the measured response using a known field distribution and will be used to help design an electrical tip shape profiler reference material.

SII - 62 Hanna Lyle, Roanoke College, *Exploring the geology of Mars through analysis of Mössbauer spectroscopy data collected by NASA's Mars rovers*
In 2003 NASA sent two rovers, Spirit and Opportunity, to Mars to study the composition of the planet. One method of analysis used by the rovers was Mössbauer Spectroscopy, with the MIMOS II instrument, which characterizes specifically iron-bearing minerals, using recoil-less emission and absorption of gamma rays in iron nuclei. The data here shows the analysis of Mössbauer data from both rovers, using RECOIL software, from 50 to 2000 sols, and the resulting identification of mineralogical phases in different locations across the planet on similar sols. Minerals identified from Spirit's data at Gusev Crater were mainly olivine ($(Mg, Fe)_2SiO_4$) and pyroxene ($(Fe, Mg, Ca)SiO_3$), while hematite (Fe_2O_3) and magnetite (Fe_3O_4) were found in addition to olivine and pyroxene, in the samples analyzed by Opportunity at Meridiani Planum. Jarosite ($KFe_3^{+3}(OH)_6(SO_4)_2$), a mineral identified from Opportunity's data, is of particular interest because it is known to only form under aqueous conditions, implying that water likely existed on Mars in the past. In addition to analysis of the rovers' Mössbauer spectroscopy data, sodium and potassium types of jarosite were synthesized in the lab and further analysis of the mineral was performed using IR Spectroscopy and X-ray Powder Diffraction.

SII - 63 Tara Pena, Adelphi University, *Development of a Simple Optimization Algorithm for Use in Atomic Physics Experiments*
We are developing optimization algorithms which we will later use to coherently control atomic excitation and ultracold atomic collisions with a nanosecond frequency chirped laser. We have used a simple genetic algorithm to optimize the results of numerical calculations of atomic excitation with the optical Bloch equations. In order to test the genetic algorithm out in a simple physical environment, we used it to optimize the output of a passive band-pass filter (1.5 - 7 KHz) by controlling the input with an arbitrary waveform generator. We have found that we can generate a near 2 KHz ramp wave with a residual of 0.3% in 40 generations using the optimization algorithm. We are currently exploring using the algorithm to control atomic excitation of Rb atoms.

SII - 64 Brian Carvajal, The Pennsylvania State University, *Mapping out Interactions between NV and P1 Centers*
Paramagnetic point defects within diamond, specifically negatively charged nitrogen-vacancy (NV-) centers, have attracted significant recent interest high sensitivity magnetometry with nanoscale resolution. In this context, it is important to understand the interactions between NV-centers and substitutional N impurities (P1 centers). In particular, polarizing the P1 center spin bath could improve coherence times of the NV- spins and improve the ultimate sensitivity of NV center magnetometers. To explore the underlying physics, we performed optically detected magnetic resonance (ODMR) measurements at microwave powers exceeding 1W. We found a strong laser power dependence of the contrast of the ODMR sideband signals, which occurs due to mutual spin flip transitions of both centers. By measuring the microwave power and magnetic field dependence at varying laser powers, both before and after the point of saturation, we gained insights into the dynamics of the interactions between the NV- and P1 centers. This work was supported by the Penn State REU program and by NSF-DMR1460920.

SII - 65 Melvin Kenney III, Morehouse College, *Adhesion Measurements of functionalized AFM Cantilevers on Shewanella Oneidensis MR-1*
Bacteria were among the first life forms to appear on Earth, and are present in most environments. The purpose of our experiment was to use an Atomic Force Microscope (AFM) to make nanoscale adhesion measurements on bacteria. By chemically functionalizing the AFM's cantilevers we observed different adhesive forces between the bacteria,

Shewanella Oneidensis and the AFM cantilever. The cantilevers were functionalized with the hydrophobic film Octadecyltrichlorosilane (OTS) , the protein biotinylated bovine serum albumin (BBSA), and the non-functionalized cantilever was used as our control.

SII - 66 Jeremiah Wells, USAFA, *Fine Structure Excitation Transfer in Rb-Buffer Gas Mixtures*

The purpose of this experiment is to measure the collisional excitation transfer rates between Rb 5P states in the presence of buffer gas mixtures. Rubidium is excited to the 5P3/2 state with a 780 nm photon and then collision with a buffer gas results in excitation transfer to the 5P1/2 state followed by emission of a 795 nm photon. Previous studies showed a nonlinear dependence of the excitation transfer rate with the He pressure. We interpreted this increase in terms of three body collisions and developed a theoretical model based on interatomic potentials to explain our experimental results. To better understand the three body collision process and further test our model, we are investigating the excitation transfer process in buffer gas mixtures of He-Ar and He-Xe. We expect to see an increase in excitation transfer in the presence of Ar or Xe even though their excitation rates are much lower than those of He. We will present our experimental results at the conference.

SII - 67 Aleksandar Tadic, California State University, Sacramento, *Self-Balancing Resistance Bridge as Cryogenic Temperature Measurement System*

A self-balancing resistance bridge was developed for use in a cryogenic temperature measurement system. In this system, a wheatstone bridge is used in conjunction with a lock-in amplifier to measure the resistance of a carbon resistor, whose resistance depends on the temperature. Self-balancing of the bridge is achieved through LabVIEW, along with a voltage controlled resistor which was designed for this purpose and consists of an enclosed LED-photocell system. Changes in the voltage to the LED changes its brightness, which in turn changes the resistance of the photocell. Tests show that the system should meet the needs of the low temperature lab.

SII - 68 Sonia Cyuzuzo, Abilene Christian University, *The Study of Gamma-ray Detection With a Plastic Scintillator*

Plastic scintillators are known to be physically robust and relatively inexpensive per unit area in comparison to NaI and high-purity germanium (HPGe) crystal detectors that are widely used in gamma spectroscopy applications. For this reason, in this research, gamma-ray detection with a plastic scintillator detector was studied using a combination of bulk counting, a multichannel analyzer, and GEANT4 simulations. The objective was to increase the number and uniformity of gammas detected throughout the detector by optimizing optical photon collection from20-1300keV. The detector studied is 2"x5"x48" and has a photomultiplier tube on one 2" end with different layers of covering material.

SII - 69 Pawan Gaire, Howard university, *Fabrication and Characterization of Diamond Field Effect Transistors*

Since the development of first microprocessor in 1971, the number of transistor has been increasing. According to Moore's law the trend of increasing the number of transistor per unit are by two times has been predicted to hold for about a decade more. With such trend, the next generation of electronic devices would require material can handle higher power and frequency. Diamond's excellent properties like highest thermal conductivity, high band gap, high breakdown voltage, low thermal expansion makes it ideal for these applications. This summer we fabricated p-channel MESFETs on hydrogen terminated diamond using lithography, metalization and took the measurement using probe station and oscilloscope. During the process we ran to some problem such as e-beam evaporator stopped working and we had to optimize the process, we used thermal evaporator for both Gold and Aluminum deposition. We found that due to high dielectric breakdown voltage of diamond, we couldn't see the breakdown region in shcottky diode although we passed 100 percentage of current through oscilloscope.

SII - 70 Wyatt Williams, University of Nevada, Reno, *FXR Image Processing and Analysis Using NSTec's RadPro and Imagetool Software*

The Flash X-ray Accelerator (FXR) is a diagnostic tool used to create radiographic images of high speed events. The goal of this project is to increase the turnaround rate of processing images and analysis, while also providing consistency in user measurements while performing experiments at the FXR. NSTec's software packages RadPro and Imagetool are used for processing and analysis of radiographic images. RadPro allows the user to choose algorithms to clean up the image that include de-starring, rotating, masking bad columns of pixels known as tile boundaries, and reducing background obstructions from a flat-field image. After RadPro cleans up the radiograph, Imagetool can be used to calculate a beam spot size. By using a box-cursor to analyze a region where the contrast changes sharply from black to white to produce a Line Spread Function. The Line Spread Function resembles a Gaussian Distribution, where the Full Width Half Max gives information about the beam spot size. The creation of a "lockbox" function allows the user to save and load multiple boxes and sizes across different regions of the radiographic image for analysis. This helps create consistency and finer adjustments to the beamline in order to create the smallest possible beam spot size.This work was done by National Security Technologies, LLC, under Contract No. DE AC52 06NA25946 with the U.S. Department of Energy. DOE/NV/25946Ñ3013.

SII - 71 Jordan Rice, Carthage College, *Observing Very Low Frequency (VLF) Electromagnetic Waves as a Function of Altitude via RockSat-X*

Lightning strikes emit Very Low Frequency (VLF) electromagnetic waves that propagate around the globe by reflecting off the lower regions of the ionosphere and the Earth's surface. Our payload, designed for the RockSat-X program, was built to investigate and better our understanding of how the ionosphere interacts with VLF waves and how energy from these waves can escape into the magnetosphere. As satellites are too high above the ionosphere, and ground receivers are too low, a rocket provides the perfect range to investigate this energy leak. Our payload was the first to investigate VLF waves in this range by using three magnetic loop antennas in all three axes to listen for the magnetic field component of the VLF waves and two dipole plate antennas for the electric field component. This payload flew on a Terrier Improved Malemute launched from NASA's Wallops Flight Facility in Virginia on August 17th, 2016, but was never recovered. The results of our experiment could provide a foundation to improve a satellite's lifetime and provide better protection against harmful particles that are removed from the radiation belts by the energy of VLF waves.

SII - 72 Brean Prefontaine, Drexel University, *Development and Assessment of Particle Physics Summer Program for High School Students*

A four week long immersive summer program for high school students was developed and implemented to promote awareness and understanding of university level research. The program was completely directed by an undergraduate physics major and included a hands-on and student-led capstone project for the high school students. The goal was to create an adaptive and shareable curriculum in order to influence high school students' views of university level research and what it means to be a scientist. The program was assessed through various methods including a pre and post survey developed for this program, a previously vetted student attitudes toward STEM survey, weekly blog posts, and an oral exit interview. The curriculum included visits to local STEM laboratories, an introduction to particle physics and the IceCube collaboration, an introduction to electronics and computer programming, and their capstone project: planning and building a scale model of the IceCube detector at the South Pole. At the conclusion of the program the high school students gave two presentations showcasing their project. One presentation was an outreach event to the general public at the Franklin Institute in Philadelphia and the other was a formal oral presentation to the Department of Physics at Drexel University. More details concerning the curriculum and its development will be shared. The results of the program assessments showed that the students' attitudes toward STEM were shifted due to participation in the program.

SII - 73 Amy Glazier, Austin College, *Towards Understanding Variability in Be Stars*

Emission-line B-type (Be) stars exhibit emission lines in their spectra caused by a circumstellar disc. For many Be stars, the emission signatures vary in strength and character over time, but the causes of this variability are not well understood. In order to shed light on the question of why Be stars' discs vary in the ways that they do, we have studied a subset of Be stars surveyed by the Apache Point Observatory Galactic Evolution Experiment (APOGEE). We find that spectral type and rotational velocity do have a possible influence on variability in Be stars. Although stars with early spectral types and large ratios of rotational to critical velocity are not exclusively coincident with both V/R variability and disc dissolution/ reemergence, the majority of our stars that depicted either type of variability could be classified as such. Further, stars that show shorter periods of variability also tend to have earlier spectral types and rotational velocities that are closer to their critical velocities.

SII - 74 Nathaniel Miller, University of Dayton, *Comparison of Different Numerical Methods for Analyzing Antennas*

Folding-reflector antennas are currently envisioned as a possible solution to providing an increase RF performance for satellite antennas. However, the current effects of the reflector sparseness and faceting has not yet been determined. Due to the cost of building a large scale antenna for testing, numerical methods must instead be used to give an assessment of how the antenna will perform. Due to the numerical complexity of the problem, a method must be chosen that gives suitable accuracy while staying within computational limits. Two approaches will be discussed, one using geometric optics, and one using the integral solver within Computer Simulation Technology Suite (CST). This poster will compare the accuracy of these two methods to predicting the performance of a known antenna and a comparison will be given of the computational complexity of these two approaches.

SII - 75 Hannah Thigpen, Davidson College, *Photodetachment From The O- Ion At The 2P1/2 --> 3P0 Threshold*

A Penning ion trap and a tunable, amplified diode laser were used in this photodetachment experiment to resolve the cyclotron structure of the 2P1/2 → 3P0 transition in the O- ion. We searched for the transition threshold by scanning across multiple photon energies and gathered data that places the threshold approximately five wave numbers below its anticipated energy. Repeated patterns in our observations indicate the resolution of high-n cyclotron peaks that typically blur out as energy from the transition threshold increases.

SII - 76 Collin Epstein, Davidson College, *Testing Digitome¨ with Computed Radiography*

Digitome¨ is a 3D, volumetric x-radiograph program that uses 8-16 radiographs taken from different perspectives of an object or volume of interest to compute a 2D planar view of any level, angle or orientation. Previously, Digitome¨ exams have been generated using digital radiography (DR) plates because of the importance of precisely known alignment between the object and the plate when computing exams. We demonstrate that we can use computed radiography (CR) plates to obtain Digitome¨ exams of comparable quality to those taken using DR plates. Furthermore, we examine how CR enables us to take higher resolution exams than are with generally available DR plates.

SII - 77 Cecily Towell, Abilene Christian University, *Improving Timing Resolution of Particle Detectors*

Quantum Chromodynamics (QCD) is a fundamental theory that successfully explains strong force interactions. To continue the effective study of QCD in nuclear structure, plans are being made to construct an Electron Ion Collider (EIC). Preparation for the EIC includes continued detector development to make detectors as efficient and precise as possible. This includes Time of Flight (TOF) detectors, which are used for particle identification. Multi-Gap Resisitve Plate Chambers (mRPCs) are a type of TOF detector that typically use glass to make small gas gaps within the detector to quickly read out the electric charges produced when a high energy particle goes through the detector. These extremely thin gaps of 0.2mm are key in achieving the excellent timing resolution these detectors are capable of. A new mRPC design is being tested with the goal of reaching a timing resolution of 10ps. This design uses sheets of mylar in place of the glass so that the width of the dividers is smaller. Multiple versions of this mylar mRPC have been made and tested. The methods for producing these mRPCs and their performance will be discussed.

SII - 78 Sarah Pazos, Louisiana Tech University, *Synthesis and Characterization of 2-D Van der Waals Heterostructures*

Atomically thin Transition-metal Dichacogenides (TMD), Graphene, and Boron Nitride (BN) are two-dimensional materials where the charge carriers (electrons and holes) are confined to move in a plane. They exhibit distinctive optoelectronic properties compared to their bulk layered counterparts. When combined into heterostructures, these materials open more possibilities in terms of new properties and device functionality. In this work, WSe2 and Graphene were grown using Chemical Vapor Deposition (CVD) and Physical Vapor Deposition (PVD) techniques. The quality and morphology of each material was checked using Raman, Photoluminescence Spectroscopy, and Scanning Electron Microscopy. Graphene had been successfully grown homogenously, characterized, and transferred from copper to silicon dioxide substrates; these films will be used in future studies to build 2-D devices. Different morphologies of WSe2 2-D islands were successfully grown on SiO2 substrates. Depending on the synthesis conditions, the material on each sample had single layer, double layer, and multi-layer areas. A variety of 2-D morphologies were also observed in the 2-D islands.

SII - 79 Sebastian Hendrickx-Rodriguez, New Mexico Institute of Mining and Technology, *Three Dimensional Modeling of Asteroids*

The asteroid belt is estimated to contain over one million asteroids, but only a few hundred have a three dimensional model. This research aims to use existing light curve data to recreate the shape of asteroids in order to gain as much information as possible about these celestial objects. By observing an asteroid at several different phase angles, a process that could take years, it is possible to inversely create a shape that produces the light curves observed. The asteroid 21 Lutetia's shape was determined by using this process and was compared to a flyby of the asteroid on July 2010. The convex model of the asteroid approximately displayed the rough shape of the object. Moreover, the more complex nonconvex model was later created by other researchers and truly shows how powerful the inversion method is. An asteroid that passes near the Earth can also be modeled if several researchers observe it as it flies by. This was the case for asteroid 47035 1998 WS. This study shows how powerful and versatile the inversion process can be, making it a very important tool for asteroid mining and collision prevention.

SII - 80 Annette Lopez, California State University, Fresno, *Parton Distribution Function Reweighting and Associated Uncertainties in a Search for Dark Matter with the ATLAS Detector*
Investigating the properties of a proton involved in a proton-proton collision at the Large Hadron Collider furthers our understanding of resulting processes from the collision. In the search for dark matter produced alongside a new heavy resonance, Z', or a W/Z boson, a process characterized by large missing transverse momentum from the undetected dark matter particles, parton distribution functions (PDFs) of protons were utilized to improve the Monte Carlo simulation of proton-proton collisions at SQRT(s) = 13 TeV with the ATLAS detector. PDFs influence the luminosity of the partons of the protons colliding, as well as the luminosity of the underlying events which compose the background of a collision. The PDF set NNPDF30 leading order was used to generate events with applied cuts: missing transverse momentum greater than 250 GeV, pseudorapidity of $|\eta| < 2.5$, and groomed jets with R = 1.0. An algorithm was developed to do PDF reweighting from NNPDF30 leading order to the following PDF sets: NNPDF30 next-to-leading order, MMHT2014, HERAPDF20, CT14, and MSTW2008. Distributions of the transverse momentum, mass, azimuthal angle, rapidity, and pseudorapidity for the leading and subleading jets, as well as the missing transverse momentum, were produced with the PDF reweighting algorithm. The uncertainty associated with the choice of a particular PDF in creating these distributions was calculated.

SII - 81 Rachel Buttry, Drexel University, *Observing the Seasonal Variation of Muon Flux with IceCube*
High energy atomic nuclei accelerated in space known as cosmic rays are constantly hitting Earth's atmosphere, producing pions and kaons which decay into fundamental particles such as neutrinos and muons. The atmospheric muon flux depends on the density of the atmosphere. Because the density of the atmosphere depends heavily on temperature, we study the variance of the muon rate over the year using the IceCube South Pole Neutrino Observatory--a neutrino telescope buried under glacial ice at the geographic South Pole that is one cubic-kilometer in volume.

I analyzed a year's worth of IceCube dataseeking a trend in the seasonal variance of muon flux. The rate of muons followed a clear sinusoidal pattern with its peak in January and its trough in summer."

SII - 82 Aaron Rodriguez, St. Mary's University, *Construction of a Raspberry Pi Computer Cluster with Scalable Capabilities in Linear Algebra Calculations*
In general, the cost of high performance computing systems composed of clusters of computer nodes working in parallel is very high. Institutions with the financial means to purchase and maintain a cluster system have a clear advantage in scientific research with their students publishing significantly more academic papers than those schools without these resources. In addition, students from these latter schools will graduate without the skills and experience gained from conducting research with parallelized environments and will be at a disadvantage in graduate school or industry. We have addressed this issue by creating a small scale and low cost Linux cluster based upon the Raspberry Pi architecture. We estimate that these systems will cost an order of magnitude lower than commercial cluster systems and will be comparable in performance. Our team focused on the creation of this cluster using open source Debian and Hadoop software suites. They were chosen because the Debian suite has a loyal and flourishing community of contributors and Hadoop has an established set of techniques for the manipulation of both sparse and dense matrices. Our cluster was able to pass benchmark testing, and we are currently determining its proficiency in parallelizing linear algebra routines, in particular, the diagonalization of floating point matrices which is a common numerical operation needed in computational physics and chemistry.

SII - 83 Benedict Mondal, University of Maryland, *Supersymmetric Holoraumy*
Starting from three minimal off-shell 4D, N = 1 supermultiplets, using constructions solely defined within the confines of the four dimensional field theory we show the existence of a "gadget" Ñ a member of a class of metrics on the representation space of the supermultiplets Ñ whose values directly and completely correspond to the values of a metric defined on the 1dN = 4 adinkra networks adjacency matrices corresponding to the projections of the four dimensional supermultiplets."

SII - 84 Daniela Marin, William Jewell College, *Schlieren Imaging of Viscous Fingering*
Viscous fingering (VF) is the formation of finger-like patterns due to interfacial instabilities between one fluid being injected into another. Difficulties arise when trying to image boundaries of certain flows due to their transparent nature. Typically, the characteristics are viewed by adding a chemical indicator to the fluid and displacing it through a Hele-Shaw cell. However, it is uncertain whether such indicators alter the stability of the flow. Schlieren imaging is a optical technique that allows visualization of the features without interfering with the stability. This field has been under experimentation to provide information about fluids' behavior that could be beneficial to some of its applications such as enhanced oil recovery, pollutant dispersion in underground aquifers and climatological issues.

SII - 85 Benjamin Bouricius, Ithaca College, *Get a Grip: Designing an Opposable Thumb on a 3D Printed Mechanical Prosthetic Hand*
Organizations like e-NABLE have been created in recent years to make 3D printing more accessible for those in need of affordable prosthetic hands. Hand designs such as the Raptor prosthetic hand are open-source and available for free online. My research has focused on the modification and improvement of this particular hand design, with the goal of designing an opposable thumb based off of the original Raptor thumb. A few modifications include adding grip to the fingers, adding a tuner rack to control the tension in idividual tendons. My new thumb design allows for precision grip with pinched thumb and forefinger, something which is nearly impossible for the original Raptor as well as for many similar hand designs. My modified raptor hand is wrist-actuated and entirely mechanical, like the original. This is crucial in that it serves to keep the design affordable. Conventional prostheses can cost thousands of dollars, due in part to the fact that many prostheses available today incorporate electronic components. My design has the benefit of not needing heavy motors, batteries or intricate circuitry, thereby keeping it inexpensive and light. I am paying special attention to the angle between the thumb and forefinger and its influence over the hand's ability to grip objects with precision. With my own natural hand, I find that my thumb and forefinger do not meet in direct opposition, but instead my thumb approaches at an angle. I expect that the modified raptor hand will function best with this natural thumb alignment.

SII - 86 Keenan Hunt-Stone, Howard University, *DREAM2: Using Apollo CPLEE Observations to Constrain Lunar Surface Charging*
The Charged Particle Lunar Environment Experiment (CPLEE) was deployed during the Apollo 14 mission to measure electron and ion fluxes incident at the surface of the Moon. This study focuses on utilizing CPLEE observations to investigate the interaction between the Moon and the surrounding space plasma environment; in particular, determining the electric potential between the lunar surface and ambient plasma under different conditions. Previous analyses of CPLEE data reported a lunar surface potential of >200 V positive on the dayside when the Moon was in the plasma sheet region of the Earth's magnetotail; this is about an order of magnitude greater than expected from surface charging models. During our investigation we re-evaluate the constraints that can be placed on the

sign and magnitude of the lunar surface potentials using CPLEE data. By curve-fitting Maxwellian distribution functions to CPLEE energy spectra we can well-constrain the plasma temperature; however, we have not yet found any truncations in the energy spectra indicative of surface charging effects (likely due to CPLEE's high energy threshold of 40 eV). Therefore, variations in ambient plasma concentration and surface potential cannot be uniquely distinguished, thus we obtain a family of possible solutions for these two parameters.

SII - 87 Sergio Smith, Howard University, *Long-Term Timing of Globular Cluster Pulsars*
Pulsar timing is a powerful astrophysical tool that allows us to study both pulsars and their environment. Timing models provide information about the pulsar itself, including mass, position, and orbital parameters for pulsars in binary systems. Timing models also provide information about the pulsar's neighborhood and about the interstellar medium (ISM) between the pulsar and the Earth. We present the results of timing two millisecond globular cluster pulsars over five years, as well as steps involved in preparing the data for use in the timing model. Data was obtained using the Robert C. Byrd Green Bank Telescope (GBT) observing at 1.5 GHz between 2011 and 2015. Here, a description of the data processing procedure is given, and timing results including dispersion measure and higher order rotational period derivatives are discussed.

SII - 88 Thomas Steele, Ithaca College, *Preserving History: Laser Scanning an Irish Castle*
During the Summer of 2016, a team of four undergraduate researchers from Ithaca College's physics department and professor Michael 'Bodhi' Rogers traveled to Ireland in order to do a 3D scan of Trim Castle, in County Meath. The castle dates back to the 12th century and is the largest Anglo-Norman castle in Ireland. Over the course of the trip the team scanned the castle, as well as much of the surrounding medieval landscape. The scanner the team used, the Leica C10, uses a green 532 nm wavelength laser that pulses fifty thousand times each second, recording the reflection time and calculating the distance to each point scanned. The scanner is accurate to 2 mm, can scan 360 degrees horizontally, 270 degrees vertically, and at a distance of 300 m. From each scan station we conducted a lower resolution 360 degree by 270 degree context scan that also included photographs, and 5 mm resolution detailed scans of architecture of interest. The photographs are used to assign RGB values to the individual location points; referred to as a point cloud. The size of the project yielded a large amount of data, which is still being processed at Ithaca College in order to obtain a finished model of the castle. This model can be used not only for historical preservations, but could potentially serve as the basis for further research, as well as allowing for a virtual tour of the castle grounds to be created.

SII - 89 Mark Cratty, California State University, Sacramento, *Hadamard's Method and the Heisenberg Subelliptic Laplacian*
In 1973, Folland constructed the fundamental solution of the sublaplacian on the Heisenberg group, using the group of dilations and mimicking the case of the Euclidean Laplacian. In our work, we take a different approach. Recent developments in geodesic theory for the sublaplacian lead us to use a different geometric method pioneered by Hadamard. We add an auxiliary term to the sublaplacian to make it a wave-type operator. Then we apply Hadamard's parametrix construction, which Hadamard used to solve the Cauchy problem for the wave equation on a curved space-time. The Hadamard parametrix we construct approximates the fundamental solution for the wave-type modified operator. It is singular along the surface of a conoid. Finally, we take the limit as the auxiliary term goes to zero. We then compare our form of the fundamental solution of the sublaplacian to Folland's.

SII - 90 Rachel Parziale, University of Wyoming, *Characterizing Star Clusters in Nearby Galaxies*
Dwarf galaxies are similar to 'normal' galaxies like our Milky Way except they are 100-1000 times smaller. However, dwarf galaxies are key to understanding galaxy evolution since they vastly outnumber normal galaxies, and in fact, normal galaxies likely formed via the accretion of dwarf galaxies; dwarf galaxies are thought to be the building blocks of galaxies in a hierarchical universe. Despite their abundancy in the local Universe, the understanding of star formation in dwarf galaxies is still incomplete. For example, it is a mystery why dwarf galaxies exhibit a paucity of ionizing photons, photons energetic enough to strip the electron from a Hydrogen atom. Is this paucity due to a lack of very massive stars, stars 10-50 times as massive as our Sun? This project aims to understand the lack of ionizing photons in dwarf galaxies. I will first identify all star clusters (a grouping of tens to hundreds of thousands of stars) within 29 dwarf galaxies using images downloaded from the Hubble Space Telescope archives. After the identifications have been carried out, I will measure each cluster's brightness at a variety of wavelengths, and use this information along with theoretical stellar models to infer the clusters' ages and masses. With this information in-hand, I will be able to determine whether dwarf galaxies indeed lack a population of very massive stars.

SII - 91 Zach Wimpee, Angelo State University, *ECAL Energy Flow Calibrations*
For the Fall semester of 2015 I was given the opportunity to assist in research at CERN, the European Organization for Nuclear Research. I worked alongside some of the world's leading physicist on the CMS experiment of the Large Hadron Collider in an effort to further calibrate the Electromagnetic Calorimeter (ECAL). ECAL's purpose is to detect and measure the energies of incoming photons and electrons, and this played a vital role in the discovery of the Higgs Boson in 2012. Due to constant bombardment by high energy radiation, the ECAL has slowly been losing response signal over time, and no possibilities exist for physical maintenance due to the scope of the machine. Therefore, corrections must be made later using conversion factors that were determined before the Large Hadron Collider had finished construction. Maintaining accurate and consistent calibrations in this part of the machine is a high priority for the scientists working on CMS because such a high degree of accuracy and stability is needed for any data analysis to be conducted. Our team was specifically focused on translating existing algorithms in C++ into Python in an attempt to cut down on computing power. Efforts were made to create of new algorithms that could be as efficient as possible in organizing the data into structures that allow for analyzing the stability of the calibrations and corrections. The ultimate goal of our team was to ensure that the corrections being made are consistent and stable within .003% as a function of time.

SII - 92 Reed Jones, Virginia Military Institute, *Polarization Measurements of NGC 6530*
We present polarization measurements of the open star cluster NGC 6530 using broadband UBVRI filters. The only previously published polarization measurements of NGC 6530 are by McCall et. al. (1990) and present only polarization measurements in the V band. Our initial multi-wavelength survey reveals that while the bright stars in the cluster have low polarization values across all bands some of measurements indicate polarization by selective extinction due to foreground dust. In their paper, McCall et al. (1990) assumed a value 3.2 for the ratio of total to selective extinction due to foreground dust. Our measurements indicate that this value is 3.24 +/- 0.04, confirming the assumption made by McCall. Furthermore, using published values of color excess for the stars we measured, we find that the average total extinction is AV = 1.16 +/- 0.11.

SII - 93 Dayton Syme, Florida State University, *Drift of Scroll Wave Filaments in a Bubble-free Belousov-Zhabotinsky Reaction Medium*
Scroll waves are a three-dimensional extension of spirals that self-organize in excitable media, such as the Belousov-Zhabotinsky (BZ) reaction. These vortices rotate about a one-dimensional curve known as the "filament". Recent theoretical work suggested that scroll wave filaments inherently pin to and drift along edges of nonreactive heterogeneities within the solution. We tested these predictions using the bubble-free 1,4-cyclohexanedione BZ reaction. Our experiments confirm the filament drift in close vicinity to the heterogeneity. The drift velocity is affected by a change in the solution's depth, which we control by varying the height of the medium or heterogeneity. We hypothesize that beyond a critical depth, the drift velocity decreases due to the unpinned filament end lagging behind the drift direction. Our results test the limitations and current understanding of these complex patterns in three-dimensional excitable media.

SII - 94 Jonathan Daniel, California State University Stanislaus, *The missing piece of the universe*
The vast majority of matter in the universe is unaccounted for. Only 15% of the universe's mass density is baryonic matter, while the other 85% is what we call Dark Matter (DM). Indirect evidence for Dark Matter has been seen since the 1930s, but direct detection still eludes us today. Although dark matter has been shown to be inert to electromagnetic and strong interactions, weak interactions have not been ruled out. The Weakly Interacting Massive Particle (WIMP) is the forerunner of the hypothetical DM candidates for weak interactions. The Large Underground Xenon (LUX) experiment was designed to directly detect WIMPs. LUX already analyzed its full 322 days (Run4) data using a Spin-Independent Model for WIMPs. Our analysis will seek out the Spin-Dependent Model for Dark Matter, where the WIMP's interaction is coupled to the spin of the protons and neutrons within the Xenon's nucleus. Confirmed or denied, the LUX experiment will pave the way for further refined experimentation & development into the exploration of Dark Matter.

SII - 95 Tamas Almos Vami, Wigner Research Centre for Physics, Budapest, *Reconstruction of the CERN CMS Pixel Pilot Blade*
The Compact Muon Solenoid (CMS) is a general-purpose detector used to study the products of high energy particle interactions at the CERN LHC. The silicon pixel detector is the innermost component of the CMS tracking system. The present pixel detector will be replaced by an upgraded version, called the Phase 1 Pixel Upgrade in the beginning of 2017. During the last shutdown period of the LHC, a third disk was inserted into the present two-disk forward pixel detector. The new disk consists of eight modules that use new digital Read-Out Chips and a prototype readout system. Testing the performance of this Pilot System enables us to gain experience with the CMS Pixel Phase 1 Upgrade modules. In the poster, my experiences with the Pilot System simulation, the offline calibration procedures, and the re-commissioning of the pixel detector during first data taking in 2016 will be presented, with special regard to these new modules.

SII - 96 Xavier Bonner, Morehouse College, *Analysis of Repetitive Elements of RNA-Sequencing Data*
Using RNA-sequencing (RNA-Seq), we can determine how genes are expressed in different biological samples, such as cells, tissues, or individuals. Repetitive elements are repeated sequences in DNA, which comprises over 40% of the genome. It has been shown that repetitive elements are expressed especially during embryonic and germ cell development. However, RNA-Seq analysis pipelines have primarily been developed for non-repetitive sequences, and accurately aligning repetitive element transcripts to the genome is challenging because they can map to multiple regions in the genome and can result in mapping. The aim of this study is to determine how well different mapping softwares align repetitive element reads to a reference genome. We compared three RNA-Seq alignment softwaresÑTophat2, BWA, and STARÑon their mapping accuracy, memory consumption, and computational time to determine which algorithm can most optimally align repetitive element transcripts to the genome.

SII - 97 Eesha Das Gupta, Drexel University, *TiSe2 Thin Film Growth Using Chemical Vapor Transport*
1T-TiSe2 is a transition metal dichalcogenide, a class of compounds with 2D layered structure, that exhibits chiral charge density wave transition and superconductivity. Chiral charge density wave could be exploited in electronic applications. However, to be used in devices, large area homogeneous thin films of TiSe2 are required. We were successful in growing patches of homogeneous few-layer TiSe2 thin films using chemical vapor transport. Our samples had TiSe2 thin films with thicknesses ranging from 3 to 30 nm, showing that chemical vapor transport could be a viable method for thin film growth. We characterize our films using optical microscopy, energy dispersive X-ray spectroscopy and scanning probe microscopy techniques.

SII - 98 Dylan Frikken, University of Wisconsin River Falls, *Simulating Antarctic Snow's Effect on IceTop's cosmic ray detection*
Cosmic rays are high energy subatomic particles moving at nearly the speed of light that are produced in extreme environments in outer space. The study of cosmic rays play an integral role in our understanding of the universe. IceCube, an international collaboration, aims to study cosmic rays using a one cubic kilometer detector constructed in the ice at the South Pole. IceTop is the surface component of the IceCube Neutrino Observatory. IceTop detects showers of charged particles resulting from primary cosmic rays interacting with the Earth's atmosphere. The goal of this project was to investigate the impact of snow that is accumulating on top of the IceTop tanks. Preliminary results of computer simulations show that the snow decreased the electromagnetic portion of the showers as expected, but also showed that the snow had a greater effect on the muon component of the shower than expected. Preliminary simulation results of the snow's effect on the response of the IceTop tanks at the South Pole for an E-1 spectrum will be shown.

SII - 99 Samuel Montgomery, New Mexico Institute of Mining and Technology, *Gamma Rhythm Simulations in Alzheimer's Disease*
The different neural rhythms that occur during the sleep-wake cycle regulate the brain's multiple functions. Memory acquisition occurs during fast gamma rhythms (20-80Hz) during consciousness, while slow oscillations (<1Hz) mediate memory consolidation and erasure during sleep. At the neural network level, these rhythms are generated by the finely timed activity within excitatory and inhibitory neurons. In Alzheimer's Disease (AD) the function of inhibitory neurons is compromised due to an increase in amyloid beta (Aβ) leading to elevated sodium leakage from extracellular space in the hippocampus. Using a Hodgkin-Huxley formalism, heightened sodium leakage current into inhibitory neurons is observed to compromise functionality. Using a simple two neuron system it was observed that as the conductance of sodium leakage current is increased in inhibitory neurons there is a significant decrease in spiking frequency regarding the membrane potential. This triggers a significant increase in excitatory spiking leading to aberrant network behavior similar to that seen in AD patients. The next step would be to extend this model to a larger neuronal system with varying synaptic densities and conductance strengths as well as deterministic stochastic drives.

SII - 100 James Amos, University of West Florida, *NANOPARTICLE ENHANCED LASER INDUCED BREAKDOWN SPECTROSCOPY (NELIBS) INVESTIGATIONS OF CALCIUM CARBONATE STRUCTURES*
It is not well known how nanoparticle deposition on sample surfaces effect the laser induced breakdown spectra of solid samples. In order to tackle this problem we have deposited silver nanoparticles on

the surface of selected sea shells and measured the LIBS emission spectra with 355 nm laser pulse excitations. LIBS system is calibrated for relative irradiance to facilitate comparisons of the measured spectra by other LIBS systems. We found significant enhancement and reduction of local signal intensities relative to the emission recorded from the non-silver nanoparticle coated surface of calcium carbonate structures. Detailed analysis and advantages of the effect of the nanoparticles on the surface of selected seashells will be discussed.

SII - 101 Francisco Ayala Rodriguez, University of Texas at El Paso (UTEP), *Correlations Between Thickness and Nanostructure in Soft-Templated Mesoporous Carbon Membranes*
The arrangement of mesopores in soft-templated porous carbon has been studied using small-angle x-ray scattering (SAXS). The highly porous (~8nm pore size) materials studied herein are promising for energy storage and are good model systems to probe the properties of fluid-solid interfaces. One step during synthesis requires the drying of a thin gelatinous sheet of the material. Variations in the thickness of the membranes are present and it is important to know the extent to which structure changes over large length scales (few mm). SAXS measurements reveal that the signal changes across the sample. Data reduction included, transmission corrections, detector dark noise and empty instrument background subtraction. A correlation between sample thickness and mesoporous structure, in which thin sections exhibit a more ordered porous structure of the cylindrical pores, was observed. Also, a nonmonotonic change in the pore-pore correlation distance as a function of thickness. These results highlight the importance of accounting for thickness-dependent nanostructure variations in experiments requiring large samples.

SII - 102 Caleb Hicks, Abilene Christian University, *Dark Photon Simulations at SeaQuest*
Fermi National Laboratory's E906/SeaQuest is an experiment primarily designed to study the ratio of anti-down to anti-up quarks in the nucleon quark sea as a function of Bjorken x. SeaQuest's measurement is obtained by measuring the muon pairs produced by the Drell-Yan process. The experiment can also search for muon pair vertices past the target and beam dump, which would be a signature of Dark Photon decay. It is therefore necessary to run Monte Carlo simulations to determine how a changed Z vertex affects the detection and distribution of muon pairs using SeaQuest's detectors. SeaQuest has an existing Monte Carlo program that has been used for simulations of the Drell-Yan process as well as J/psi decay and other processes. The Monte Carlo program was modified to use a fixed Z vertex when generating muon pairs. Events were then generated with varying Z vertices and the resulting simulations were then analyzed. This work is focuses on the results of the Monte Carlo simulations and the effects on Dark Photon detection.

SII - 103 Jared Barker, Abilene Christian University, *Using computer-controlled hardware to measure Optical Spectra*
We refurbished a 1960s-era, 1/3-meter monochromator by coupling its crankshaft to a stepper motor controlled by an Arduino UNO. Commands are sent to the Arduino via a USB serial connection using Python. This monochromator has been incorporated into a fully-automated experimental arrangement for the detection of optical emission spectra.

SII - 104 Mary Ann Mort, California State University, Sacramento, *Creating a Temperature Controller for Low Temperature Physics*
We used a Programmable System On a Chip (PSoC) to create a proportional, integral, derivative (PID) system to control the temperature of a cryogenic system. The use of the PSoC allows us to easily change the properties of the feedback system without altering the electronic components. In simulations, we found that we could attain the desired temperature by adjusting the coefficients for the PID within the PSoC program, similar to how an analog version of a PID system would behave. The PSoC provides a viable alternative to analog components especially when a variation of certain properties is probable, as this cuts down on electronic components and the need to interchange them each time.

SII - 105 Adam Rabayda, Ithaca College, *Interstellar Travel*
Interstellar space travel is a topic that is often dismissed as highly unlikely due to the vast distances involved and to considerable engineering and socioeconomic challenges. Some are left believing that it may be far from possible for us, as a species, to go anywhere beyond our solar system. We demonstrate not only the possibility of covering interstellar distances in decades or less, but also that interstellar travel is possible (in principle) with existing technology. For example: Using only special relativity and calculus, we calculated that an interstellar spacecraft could reach the Andromeda Galaxy (2.5 Million light-years from Earth) in just over 28 years at an acceleration of 9.81 m/s, which would emulate Earth gravity. We also calculated that the energy required for interstellar space travel, often deemed impossible with current technology, is, in fact, possible through certain methods such as nuclear fusion.

SII - 106 Lauren Selensky, Abilene Christian University, *Physics on the Road: Passing the Torch to K-12, but Not Near the Hydrogen Tank*
SPS has a longstanding history of reaching out to communities through its chapters. Our mission statement emphasizes "outreach services to the campus and local communities. The Road Show is an exciting and engaging demonstration of basic science principles presented through interactive performances and experiments that demonstrate physics concepts to elementary, middle, and high school students. We present 60 to 90 minute shows for audiences of more than a hundred students at area schools that are either isolated or may not have adequate resources and opportunities to interest their students in STEM related fields. Our goal is to enhance young students' knowledge and foster an enduring interest in physical sciences in a fun and fast-paced setting while teaching university students how to successfully present fundamental science principles to an audience. Road Show makes STEM accessible for grade-school students, but it also teaches university students that they are capable of leadership and inspiration. We share how SPS is making a difference in our community and throughout Texas through the Road Show.

SII - 107 Rachel Zheng, Crystal Springs Uplands School, UCSC, *Observational Biases in Tests of Gamma Ray Attenuation*
This poster presents a simulation of results from very high-energy (VHE) gamma-ray detectors on Earth in order to investigate the effects of observational biases on the detection of gamma rays. Examining VHE gamma rays is critical to understanding gamma-ray sources, such as blazars. One study, Galanti et al. (2015), examines the properties of blazars, specifically the spectral index as a function of the redshift, and has found that the spectral index decreases as redshift increases in their blazar data. The study asserts that the trend is caused by axion-like particles; however, their examination of observational biases as a possible cause of the trend was not particularly in-depth. Our resulting focus on the detection process allowed us to consider observational biases in more detail, accounting for the effective area of the telescope, the effect of the extragalactic background light, the cosmic ray particles, and the variations in sources. Preliminary results from our simulations show a trend in which the spectral index increases as redshift increases, indicating the presence of an observational bias. If the bias is confirmed, the trend found in the blazar data would be underestimating the size of the true effect. An observational bias would require the incorporation of a new correction method in the interpretation of the gamma-ray data; before we conclude concretely that an observational bias exists, we continue to investigate refinements to our simulation.

SII - 108 Andrea Kueter-Young, Siena College, *Tidal Spin Down Rates of Haumea and other Triaxial Bodies*

We use numerical simulations to measure the sensitivity of the tidal spin down rate of a homogeneous triaxial ellipsoid to its axis ratios by comparing the drift rate in orbital semi-major axis to that of a spherical body with the same mass, volume and simulated rheology. We use a mass-spring model approximating a viscoelastic body spinning around its shortest body axis, with spin aligned with orbital spin axis, and in circular orbit about a point mass.

A homogeneous body with axis ratios 0.5 and and 0.8like Haumea has orbital semi-major axis drift rate about twice as fast as a spherical body with the same mass volume and material properties. A simulation approximating a mostly rocky body but with 20% of its mass as ice concentrated at its ends has a drift rate 10 times faster than the equivalent homogeneous rocky sphere."

SII - 109 Caroline(Lige) Zhang, Drexel University, *Measurement of Electron Transport Properties in Liquid Argon*

We report the measurement of longitudinal electron transport properties in liquid argon for electric fields from 100 to 1300 V/cm. Photoelectrons are produced by illuminating a gold photocathode using a pulsed ultraviolet laser. The electron mobility and the longitudinal diffusion coefficients are measured as a function of electric fields. Our results are consistent with previous measurements in the 100 to 350 V/cm field range, and represent the world's best measurement in the region between 350 to 1300 V/cm. The measurement principle, apparatus and data analysis are also presented.

SII - 110 Eryn Daman, Virginia Military Institute, *Polarization Measurements of NGC 457*

The multi-wavelength polarization of 10 bright stars in the open cluster NGC 457 were measured and fitted to the Serkowski relationship to determine the maximum degree of polarization and the wavelength at which it occurs. The average maximum degree of polarization for the 10 bright stars measured is 2.9 +/- 0.1. The wavelength of maximum polarization ranges from 390 nm to 635 nm. While the ratio of total-to-selective extinction averages at R = 2.97 +/- 0.03 for the entire region imaged, there appears to be central area where the value of R is appreciably higher at an average R = 3.33 +/- 0.09 and is surrounded by a ring where, on average, R = 2.79 +/- 0.13.

SII - 111 Samantha Pedek, University of Wisconsin - River Falls, *Exploring the Possibility of Detecting Extragalactic Supernovae with IceCube Gen II*

The IceCube Neutrino Observatory is a one cubic kilometer neutrino telescope located deep within the Antarctic ice. It currently consists of an array of 86 strings that each contain 60 photomultiplier tubes (PMTs). Neutrinos are detected indirectly by the light emitted when they interact within the kilometer of instrumented ice that makes up IceCube. This study focused on the possibility of detecting extragalactic supernovae neutrinos. Supernova neutrinos have low energy, in 1MeV to 20MeV range, meaning they are too low to be observed above the noise rate of the detector. Fortunately, they come in very large numbers. Currently, for supernova neutrinos that originate from the Milky Way Galaxy, IceCube will "see" the background noise of the sensors increase significantly for some period of time. The signal from supernova neutrinos from outside our galaxy will spread out so much by the time they reach us, that it gets lost in the background. An extension to IceCube, Gen II, is currently in development. Studies are underway of different types of optical sensor for Gen II and, in particular, sensors that are capable of observing the signals from extragalactic supernova neutrinos. The goal of this project was to determine if the optical fibers would be more effective at "seeing" extragalactic supernovae than the traditional string of PMTs. According to this study, the optical fibers has potential to perform better than the string of PMTs at detecting extragalactic supernova neutrinos.

SII - 112 Juan Pablo Oviedo, UTD, *Surface charge/ ssDNA mediated interfacial current in the h-BN/ viscosity gradient nanopore system*

Recent experiments involving the translocation of ssDNA across the viscosity gradient/ hexagonal boron nitride nanopore system have shown a correlation between forward and reverse bias nanopore conductance values and the behavior of ionic current change with the presence of ssDNA within the nanopore. We hereby present a Poisson-Nernst-Planck finite element model of K+, Cl-, Bmim+, and PF6- ions / ion currents in solution, demonstrating how the interaction of negatively charged ssDNA with the nanopore's electric double layer yield different interfacial current behaviors which can be correlated to the experimental data observed. The understanding of these effects is critical for the proper interpretation of ssDNA translocation blockage patterns necessary for ssDNA sequencing.

SII - 113 Jared Mitchell, Morehouse college, *Optimizing Metal Mesh Filters*

Infrared (IR) blocking filters are necessary for many sub-millimeter experiments, especially for measuring the Cosmic Microwave Background (CMB). The CMB exists at ~2.7 K and differences are observed at <1mK. As such, these detectors must be kept cool to be sensitive to such small changes. If it is not mitigated, IR radiation heats whatever it comes in contact with to much higher temperatures than does the radiation from the CMB. This is called thermal loading. IR blocking filters are used to reduce this loading, however filters must not interfere with the ability of detectors to detect wavelengths of interest (~130- 170 GHz). The filters are patterned onto a polypropylene film (4 µm thickness) using photolithography and coated with aluminum. The pattern resembles a tile floor, with the parameter g describing the distance from one "tile" to the other and 2a describing the space in between tiles. The primary goal of this project is to develop a single filter with clearly defined patterned features that blocks the transmission of IR while allowing desired frequencies to transmit at a >99% rate. In order to do this, a repeatable process was found that could sharply define the grid pattern. After producing an adequate recipe, the transmission spectrum for a single filter was measured, then the parameters are iteratively adjusted until an optimal filter is produced.

SII - 114 Thayer Meyer, Virginia Military Institute, *Modeling the Topography of Non-Trivial Space*

What is the shape of the universe? Is it finite yet unbounded, like the multi-connected topologies studied by cosmic crystallographers, like Jean-Pierre Luminet? And, if it is, how could we use mathematics to determine the feasibility of measuring the size and shape of the universe? How much of the sky would we need to search to see a replication of ourselves? These questions have been answered for a toy 2D model universe, and in this research, we seek to extend these results to 3D. We begin by assuming the most basic topological structure, the 3-torus, creating a 3D lattice of repetitions of galaxy super-clusters. We then apply a set of mathematical tools, including spherical projection and Delaunay triangulations on the sphere, with the goal of developing a mathematical conjecture which, given the ratio between the maximum visible distance and the length scale of the universe, will provide the minimum cone-angle needed to guarantee that at least one lattice point will always be in view. We also discuss future work, including alternative gluings of the cube, temporal effects due to a finite speed of light and relative motion, and the expansion of the universe.

SII - 115 Umaru Waizoba, Morehouse College, *TEST FOR TIME DILATION ON COSMIC SCALES USING TYPE 1a SUPERNOVA*

Checking the validity of the consistence of the speed of light as a function of polarization state.

A discrepancy between the speed of the vertical polarization versus the speed of the horizontal polarization orthe left circular polarization (LCP) not being equal to right circular polarization (RCP) would undermine our confidence in Lorentz invariance.

Because Lorentz Invariance underlies all of special relativityand therefore all of modern physics testing the equivalence the speed of light is of fundamental importance"

SII - 116 David Holden, Morehouse College, *Termite Sidewalk*
Annually, the households in the U.S spend over 5 million dollars on termites repair. More importantly, the average cost for termite repair for a single household can cost from $1,500 to $3,000. Hence why households of low income families are at a disadvantage for covering the additional cost of termite repair in addition to other living expenses (i.e utilities, food, and mortgage). Therefore, this research was designed to develop a cost effective and humane why of dealing with Termite prevention. From our research, we we investigated, how to deter termites using light, and how termites affect to different wavelengths.

SII - 117 Cadee Hall, University of Florida, *A Parametric Amplification Measurement Scheme for MEMS in Highly Damped Media*
The Lee research group currently makes use of a planar MEMS (micro-electro-mechanical systems) oscillators in the study of quantum turbulence in superfluid 4He and surface excitations in superfluid 3He. The device possesses a resonant shear mode of oscillation, from which properties such as the viscosity of the surrounding media can be determined. Thus far, the experimental results from this device show promising agreement with theory in the low damping region. However, the oscillators often experience high damping specifically at high temperatures and/or in thin films resulting in poor signal-to-noise. The main purpose of this project is to expand the use of this device beyond the low damping regime. The use of parametric amplification to preserve a good signal-to-noise ratio is a proposed solution. This technique involves modulating the spring constant of the device at twice the driving frequency and has been shown to produce gains of over 100 in comparable devices and measurement schemes. A new measurement scheme including this amplification technique has been designed, and, when implemented, should expand the capabilities of the device to include low quality factor environments and media. A rigorous theoretical analysis of the new measurement scheme as well as preliminary experimental results will be shown, and the next steps to be taken will be presented.

SII - 118 Lauren Keyes, California State Polytechnic University, Pomona, *A Guide for Women in Physics*
Many Women in Physics (WIP) groups exist on college campuses across the United States to support women as they pursue degrees in a field in which they are typically underrepresented. However, there are limited resources in existence that help these groups navigate the complex issues that face women in physics. As a first step to correct this problem, a written guide is being developed to aid physics students and faculty in the creation and maintenance of WIP groups. It is based on data collected in surveys of one hundred people and interviews of ten people from nine different campuses in the United States. We present initial findings on the reasons why students join WIP groups, activities most valued by group members, and challenges these groups commonly face. It was found that WIP groups primarily act as social settings for women to meet other women physicists and as support systems, in which the passing down of information in mentor/mentee relationships is highly valued. It was also found that a common challenge encountered by these groups is low membership and participation. These findings are compared to what has been observed in literature to determine whether or not it is supported by previous research. Finally, this information is put into the context of the written guide and shown how it can be of use to WIP groups.

SII - 119 Eric Cedotal, Virginia Military Institute, *Internal Conflict Inference and Prediction Using Supervised Machine Learning Techniques*
This project looks at independent variables and how they relate to internal conflict in countries across the globe, specifically their ability to predict. This research examines the evolution of internal conflict over time, as well as the effect of two different machine learning and imputation techniques on predictive capabilities. Data gathered from several sources made up the data set of 10,578 data points, containing 209 countries and up to 64 years' worth of data for each, and 1,810 variables, both categorical and numerical for both. Various imputation techniques were used to make the data set usable for machine learning algorithms. The results from stepwise regression show that conflict has quantifiably changed over time and that previous conflict is the best predictor of future conflict. Decision tree algorithms show that for the purposes of this research, they produce the most accurate results when using data set imputed using only past values.

SII - 120 Spencer Leeper, University of West Florida, *Properties of a Quantum XXZ Model with Long-Range Interactions*
In recent years, rapid advancement has been made in using ultra-cold gases as quantum spin simulators, with two dimensional lattices becoming a rich target for exploring the exotic states and excitations of spin-1/2 systems on lattices. When the interaction in the system becomes long-ranged, the spins are frustrated by the long-range interaction. Here, we investigate the quantum dipolar XXZ model with exact diagonalization on a square lattice to characterize the ground state and excitations and build a phase diagram.

SII - 121 Aaron Watson, Pacific Union College, *A Survey of the Ionization Energies of the DNA Nitrogenous Bases via DFT-Based Calculations of their Potential Energy Surfaces*
The knowledge of the ionization energies (IE) of the four nitrogenous bases of DNA is crucial in understanding the DNA damage processes. So far, both theoretical and experimental results show that guanine has the least IE [J. Phys. Chem. Chem. Phys., 2014,15, 13833-13837]. But even though the measured IEs seemed to be consistent with the calculated ones, they are not in good agreement. The disagreements might be due to the fact that the IE depends on the location of the leaving electron and its electronic environment. Besides, the calculations of the IE of a molecular ion need the consideration of all directions that are indispensable to define the geometry of the molecule. In this study, we considered a relaxed neutral nitrogenous base, which is also assumed to be the geometry of the cation right after its formation. Each single atom of the neutral base and each single atom of the cation are considered as a site of the departing electron and the corresponding potential curves are calculated in all three directions using the density functional theory while all other atoms are assumed to be frozen during the ionization. Thus, this method of calculations of IE is an all-direction survey of the IEs of the DNA nitrogenous bases. It is different from the standard ones that lead to either vertical IE or adiabatic IE. It gives access to the potential energy surfaces and IEs that are in good agreement with some measurements. The results are reported and discussed in this presentation.

SII - 122 Avi Radick, California State University, Chico, *Observing Polarization Correlation in Gamma Photons*
We are developing an experiment for our upper division laboratory course that is designed to illustrate quantum entanglement of photons by using as a source the two .511 MeV photons resulting from the decay of positronium. For a number of years the laboratory has had an operational experiment to show that these two photons are produced simultaneously and that when measured have equal energy and opposite momentum. These two photons are also emitted

in a polarization entangled bell state and by a rearrangement of the experimental geometry the same equipment can also be used to show that linearly polarizing one photon will force the other into the orthogonal linear state. Our preliminary experimental results are shown.

SII - 123 Sara Mahar, Siena College, *Fitting non-analytic distributions using a nearest-neighbor approach and bootstrap samples for regularization*
In high energy physics, parameters of interest are determined through maximum likelihood fits to projections of the data-set. Oft-times, these projections do not lend themselves to a simple analytic function and so there is no obvious way to write down the necessary probability density function (PDF). A standard procedure is to histogram the data and use the bins as a stand-in for the PDF. We explore a different approach using the density of nearest neighbors. This technique sometimes introduces a bias and so we develop a regularization technique that uses bootstrap samples of the original Monte Carlo sample at fit time. Graphics Processing Units (GPUs) are used to speed up these intensive calculations.

SII - 124 Vincent Hickl, Davidson College, *Imaging the Galactic Center at Radio Wavelengths using CASA*
The center of our Galaxy is known to be a very complex and dynamic environment which plays host to a number of interesting structures and physical phenomena. The rotational center of our Galaxy is known to be coincident with a supermassive black hole called Sgr A*, which is surrounded by a spiral thermal ionized hydrogen (HII) region called Sgr A West and a non-thermal shell-like structure called Sgr A East. The objective of this project is to image the Sgr A complex using CASA, a new data reduction package recently released by the National Radio Astronomy Observatory (NRAO). Specifically, we use observations made using the NRAO Jansky VLA interferometer at 1667 MHz, which corresponds to an OH absorption line. Once the data has been reduced, we hope to further analyze it to obtain precise magnetic field measurements for this region.

SII - 125 Jamie Bedard, Siena College, *Gravity Battery: energy storage using potential energy*
In the summer of 2016, we explored the concept of a "gravity battery." Chemical batteries are expensive and harmful to the environment so it is important to find different ways to store energy for intermittent renewable resources on a large-scale like solar and wind power. The gravity battery that we focused on is a way of storing energy as gravitational potential energy, which is then used to power a generator as the weight drops. While our prototype did not work as planned, we identified the key challenges in this device and plan to continue this work in the coming academic year.

SII - 126 Kitae Kim, Department of Physics, Pacific Union College, Angwin, CA 94508, *Wave-Particle Reconciliation via the Geometrical Interpretation of the Relativistic Energy-Momentum Relation*
E2 =p2c2 + (m0c2)2 looks like from an application of Pythagorean theorem and puts forward that pc and m0c2 could be thought of as the two axis of a plane. According to de Broglie's hypothesis, λ = h / p therefore the pc-axis is connected to the wave properties of a moving object, and subsequently. We suggest that the m0c2-axis is connected to the particle's moment of inertia rather than just its rest mass. Consequently, these two axes could represent the particle (matter) and wave properties of the moving object. On the other side, the mechanical energy is the sum of the kinetic energy (KE) and the potential energy (PE). Interpreting PE as equal to the rest mass energy m0c2, we will apply these considerations to the particular case of an electron, suggesting alternative shapes by making use of the Dirac equation. An overview of possible models and meaningful interpretations, which agree with Dirac's prediction of the electron's magnetic moment, will be presented. ([1] Dirac, P.A.M., Nobel Prize Lecture, Dec. 12, 1933, http://www.nobelprize.org/nobel\textunderscore prizes/physics/laureates/1933/dirac--lecture.pdf).

SII - 127 Joseph Crandall, The George Washington University, *Bismuth Telluride powder's particle morphologies effect on followability for use in powder bed based selective laser melting add*
Thermoelectric modules convert thermal energy to electrical energy. Exothermic reactions are created intentionally in coal, natural gas and nuclear based electricity generation. However, the stored potential energy of the fuel is not equal to the electrical energy generated due in part to uncaptured thermal energy from the reaction. Active electronic systems are exothermic due to resistance, as are biological process through internal and external processes as the organism performs work. Thermoelectrics can be applied in all of these environments to convert thermal energy into electricity availing themselves of complex geometries to optimize their efficiency.

Motivation: Traditional subtractive manufacturing Bi2Te3 processes are limited to rectangular geometries due to the ingot sintering and dicing process with up to 50% of original Bi2Te3 lost due to leg dicing after metallization. Additive manufacturing of Bi2Te3 allows for the rapidautomated manufacturing of geometries currently unavailable with little to no wasted material. Thermoelectrics operate in a solid state but suffer from conversion inefficiencies and limited operating temperatures. Optimization of thermoelectric geometries will increase conversion efficiency.

Research Objective: In order to build a selective laser melting based additive manufacturing device for Bi2Te3 the lab must answer the preliminary questions: "which Bismuth Telluride particle powder morphology and size distribution allows for the greatest followability and even distribution;" "how to distribute 100 micrometer thick layers of Bismuth Telluride powder in a repeatable process;" "how to selectively laser melt a 100µm thick layer of Bismuth Telluride powder to a previous layer utilizing a Ytterbium fiber laser."

SII - 128 Kristine Romich, City Colleges of Chicago, *DIY Astrophysics: Examining diurnal and seasonal fluctuations in the effects of solar gravity using a three-axis accelerometer*
On the surface of the Earth, the acceleration due to the influence of the Sun's gravity is approximately 0.06% of that due to the Earth's own gravity (0.0006g). Nevertheless, it may be detected using a sensitive three-axis accelerometer such as the InvenSense MPU-6050, which is compatible with the Arduino Uno microcontroller and hence provides an affordable means of investigation. Unlike the gravitational force between the Earth and an object on its surface, the x-, y-, and z-components of the gravitational force between the Sun and an earthbound observer are not constant. The vector direction of the gravitational acceleration caused by the Sun, g(sun), fluctuates as a function of the Earth's rotation (i.e., the time of day) and position in orbit (i.e., the time of year). The present investigation derives mathematical expressions for the instantaneous value of each component of g(sun) in terms of both quantities. It also outlines a method of using the InvenSense MPU-6050 to detect the corresponding fluctuations in total gravity (and, thus, the effects of the Sun's gravity) experimentally.

SII - 129 Suzanne Wheeler, Lamar University, *Finding the Shape of a Glowing Object from Polarization Measurements*
The purpose of our research is finding the shape of glowing objects based on precise polarimetric measurements of light emitted. The topic was inspired by an article published in Nature (2006) by Leonard at al., which talks about the asymmetry of a core collapse supernova based on the analysis of the degree of polarization of the core's radiation induced by the gaseous cloud around it. We built in-house a table-top setup including a blackbody cavity having small openings of various shapes to simulate the core of supernovas. Our control signal

is generated by a circular opening with a diffuser located behind it in order to eliminate the shape of the blackbody's filament. In front of the circular opening and along the setup's optical axis we place various openings of triangular shape, square, polygon, crest, etc. A complex optical system, which includes polarizers, lenses, and attenuators, is used to gather light into a high-sensitivity light sensor, while a motor allows us to steadily rotate a polarizer connected to the motion sensor. Malus' law is used for data processing: The raw data follows a cosine squared variation but with a variable amplitude depending on the shape of the opening. The analysis of these amplitudes and their departure from our control signal allows finding the shape of the openings. We acknowledge STAIRSTEP and OUR for financial support.

SII - 130 Jared Taylor, Department of Physics, Pacific Union College, Angwin, CA 94508, *Importance of atomic hydrogen source in Laboratory measurements*

We are presenting an outline of different techniques on atomic hydrogen sources and their uses in laboratory measurements on collisions that could be found in the literatures and discuss about the challenges they represent. First, there is the difficulty to create H in sufficiently large number densities. Second, there is the strain to adjust the velocities of the produced atomic hydrogens so that the collision energy would not be compromised. And third, there is the difficulty to control the internal energies of these atomic hydrogens. Special focus will be given to their use in merged-beam techniques, gas cell techniques, and traps.

SII - 131 Owen McCrossan, Drexel University, *Biomechanics of the peacock's multimodal display*

Courtship displays may serve as signals of the quality of motor performance, but little is known about the underlying biomechanics that determines both their signal content and costs. Peacocks (Pavo cristatus) perform a complex, multimodal "train-rattling" display in which they court females by vibrating the iridescent feathers in their elaborate train ornament. Here we study how feather biomechanics influences the performance of this display using a combination of field recordings and laboratory experiments. Using high-speed video, we find that train-rattling peacocks stridulate their tail feathers against the train at 25.6 Hz, on average, generating a broadband, pulsating mechanical sound at that frequency. Laboratory measurements demonstrate that arrays of peacock tail and train feathers have a broad resonant peak in their vibrational spectra at the range of frequencies used for train-rattling during the display, and the motion of feathers is just as expected for feathers shaking near resonance. This indicates that peacocks are able to drive feather vibrations energetically efficiently over a relatively broad range of frequencies, enabling them to modulate the feather vibration frequency of their displays. Using our field data, we show that peacocks with longer trains use slightly higher vibration frequencies on average, even though longer train feathers are heavier and have lower resonant frequencies. Based on these results, we propose hypotheses for future studies of the function and energetics of this display that ask why its dynamic elements might attract and maintain female attention. Finally, we demonstrate how the mechanical structure of the train feathers affects the peacock's visual display by allowing the colorful iridescent eyespots-which strongly influence female mate choice-to remain nearly stationary against a dynamic iridescent background.

SII - 132 Jeff Miller, Georgia Institute of Technology, *Efficient Analytical Models for Stars*

The polytropic models of stars are used for a variety of applications in computational astrophysics. These are typically obtained by numerically solving the Lane-Emden equation for a star in hydrostatic equilibrium under assumption that the pressure and density within the star obey the polytropic equation of state. We present an efficient analytic, piecewise differentiable solution to the Lane-Emden equation which allows "stitching" of different polytropes to represent complex pressure and density profiles. This approach can be used to model stars with distinct properties in their cores and envelopes, such as the evolved red giant and horizontal branch stars.

SII - 133 Lindsey Hart, Colorado School of Mines, *Correlations of ELVES with Lightning Data*

Emissions of light and very low frequency perturbations due to electromagnetic pulse sources, or ELVES, are a type of transient luminous events (TLEs) that are caused by lightning. The Pierre Auger Observatory, located in Argentina, has recorded and reconstructed ELVES events. The fluorescence detector (FD) is sensitive to the UV emission lines from the second positive excitation of the nitrogen molecule. The geometrical shape and arrival time of pulses onto the pixel arrays of the detector are used to reconstructed the time and location of the lightning source. That information is compared to lightning events detected from two different lightning detection systems: the world wide lightning location network (WWLLN) and the Lightning Imaging Sensor (LIS). I will present the timing and spatial correlations found between these datasets. 2 ELVES events were matched to a lightning source, while 799 were observed.

SII - 134 Glenn Newcomer, Grove City College, *WIYN Open Cluster Survey: UBVRI HDI CCD Photometry of Open Star Cluster M48*

Images of the open star cluster M48 have been obtained, reduced, standardized, and categorized by filter, exposure time, and section of sky in which the images were taken. These images were taken earlier this year by a collaborator with the WIYN 0.9m telescope at Kitt Peak National Observatory in Arizona. Cluster parameters such as its age, distance, metallicity, and reddening are determined based on this data. M48 is of particular interest due to its age in regards to surface Lithium depletion. By understanding the status of the surface Lithium, the inner stellar processes can be determined. This research is progress toward cataloguing a full profile of data that is essential for analyzing star clusters and relating them to current models of stellar evolution.

SII - 135 Macy Tush, William Jewell College, *Viscosity and Gravitational Effects on Instabilities in Particle-laden Flows in a Narrow Fissure*

Particle laden flows are two-phase flows which have a variety of applications such as chemical dispersion in the atmosphere, aerosol dispersion in medical uses, and hydraulic fracturing fluids. Hydraulic fracturing (fracking) is a common method of extracting natural gas from shale deep in the earth. A drill creates a well thousands of feet into the earth after which fracking fluid (predominately water) is pumped down where its high pressure fractures the shale. Then a fracking fluid containing proppant is pumped into the fractures so that the proppant can hold them open after the fracturing fluid is removed. Natural gas can then be extracted through the fissures. The proppant-laden fluid is an example of a two-phase flow consisting of solid and liquid. One of the most common fracking fluids and the one we will be studying is guar gum, which is thixotropic, Newtonian, and its viscosity is pH dependent. We study two-phase flows in fissures by Schlieren imaging of particle-laden flows in a Hele-Shaw cell. In particular we are interested in observing and quantifying the effects of the particles on gravitational and viscous fluid instabilities.

SII - 136 Katee O'Malley, University of the Sciences, *Digital Microfluidics: Moving Droplets of Fluids Using Electric Fields*

In digital microfluidics (DMF), droplets are manipulated by applying voltages to an array of electrodes. One merit of this technique is the absence of movable parts to transport fluids, and the instant cessation of motion by turning off electric signals. These properties make DMF an interesting choice for lab-on-a-chip technologies.

Howeverthe adsorption of analytes to surfaces also known as biofouling frequently hinders droplet motion. This is possibly the main barrier preventing a broader usage of DMF.

In particularthe application of voltages to electrodes is often associated with electrowetting where the apparent contact angle of a droplet is reduced leading to the spreading of the droplet on the surface, favoring biofouling. However it has been shown1 that droplet motion is not necessarily associated with droplet deformation or changes in the apparent contact angle. Here the main objective of the research is to continue this investigation. Starting from a simple model of a capacitor with dielectricwe are conducting simulations to determine the forces produced in a device. We will show results indicating that a droplet will move towards the region of increasing electric field without the need of deformation or changes in liquid profile. Future work will explore possibilities for the development of devices with better distribution of electric fieldsaiming at the reduction of analyte adsorption.

We thank the Lindback Foundation for financial support.

1. JonesT.B.; Wang K.L.; Yao D.J. Frequency-Dependent Electromechanics of Aqueous Liquids: Electrowetting and Dielectrophoresis. Langmuir, 2004, 2813-2818."

SII - 137 Rishap Lamichhane, Howard University, *Casual Structure of Schwarzschild Blackhole.*

The global causal structure of the schwarzschild blackhole can be studied with the help of two-dimensional compactified conformal diagram called as Penrose diagram. The diagram helps to understand the causal structure between different points in spacetime. The diagram as mentioned above is compact meaning the infinities are mapped to finite number and are conformal meaning the slope of light rays is +1 or -1. We created the diagram for the interior and exterior region of the schwarzschild geometry using Mathematica program. We drew the trajectory of both massless and massive particle falling inside the blackhole, and learnt about their fate from Classical General theory of Relativity. We also studied the differences between the co-ordinate singularity at Rs=2m and the real singularity at R=0.

SII - 138 Natalya Shcherban, Drew University, *Increasing Axial Resolution on a Line Scanning Confocal Microscope Through Tail Subtraction*

Confocal microscopes produce fine optical sectioning of specimens, and therefore have been developed for application in biological research. Current advances in confocal microscopy include transitioning point scanning confocal microscopes towards clinical application. Clinical confocal microscopes would reduce the need for traditional invasive and protracted histopathology procedures. However, current barriers to the development of a viable clinical point scanning microscope include bulkiness and large size, therefore reducing ease of use in clinical applications. A line scanning microscope, which uses half the number of optical components, reduces the microscope size and price, potentially accelerating the progression towards clinical confocal microscopes. However, a line-scanning confocal microscope experiences more loss of sectioning and increased background signal in highly scattering and turbid media such as human tissue. Therefore, a fundamental understanding of the scattering and aberrating conditions of human tissue is important. In this work we propose a potential solution to the optical sectioning problem of a line scanning microscope in scattering tissue. We built a line scanning confocal microscope using 488nm illumination and measured the axial response of the system. Through separately measuring the background, we were able to show a background subtraction method could produce a 15.7% improvement in axial resolution as well as a reduction in background. The implementation of this subtraction method for scattering media could expedite the development of a clinical confocal microscope for use on human tissue.

SII - 139 Alex Buser, Georgia Institute of Technolgy, *The Importance of Radiative Feedback for Pairing of SMBHs in Galactic Mergers*

Dynamical friction is an important mechanism in the pairing of supermassive black holes (SMBHs) during collisions of their host galaxies, allowing the pair to shed orbital energy and orbital angular momentum so that the SMBHs may coalesce. We consider the effect that radiative feedback due to electromagnetic radiation emitted during the infall of gas into the SMBHs has on the strength of the dynamical friction force acting on the SMBHs. This effect could lead to a significant increase of the predicted timescale for the coalescence of SMBH binaries formed by galactic mergers. Such a finding would have important ramifications for certain aspects of galaxy formation, as well as the observation and study of gravitational waves emitted by SMBH binaries.

SII - 140 Jessica Montone, University of Pittsburgh, *Nanomechanical Probes of SketchSETs on LaAlO3/SrTiO3*

The layering of the oxides lanthanum aluminate and strontium titanate (LaAlO3/SrTiO3) creates a structure that contains a quasi-two-dimensional electron gas at the interface of those two materials. Using atomic force microscopy, we are able to control the conducting state of this interface locally via the AFM tip. By applying a positive or negative voltage to the tip, conducting and insulating channels are created at this interface, "sketching" nanowires in patterns created using lithography software. This technique allows us to create functioning electronic devices on the scale of nanometers while being able to write and erase them freely without the need for complex procedures. We use this technique to create sketched single-electron transistors (SketchSETs), which are quantum dot-based devices that allow for the manipulation of charge flow in the form of single electrons. It is possible that the different states of the device's quantum dot can make it synonymous with a qubit, giving way to potential applications in the emerging field of quantum computation.

SII - 141 Katherine Elder, California St Univ-Fresno, *Community Outreach Through the Downing Planetarium*

The primary mission of the Downing Planetarium (at Fresno State) is public outreach. The planetarium is available to school and civic groups five days per week on a year-round basis and runs public programs at least one weekend per month. It has a 74-seat star theater with a 30-foot dome. The planetarium shows are run with a Minolta MS-10 star projector, and a full dome hemispherical mirror projection system which covers the entire dome with a movie.
In addition, we can still run any of the more than 30 programs in our traditional format library. The Downing Planetarium Museum is also available for the school field trips. The museum is located directly behind the Downing Planetarium, and consists of hands-on astronomy and physics exhibits. Each year the planetarium reaches thousands of K-12 students from around Central California, giving them attention grabbing exposure to the sciences. Many of these are elementary school students getting their first real world experiences of Physics and Astronomy. Over the decade and a half that the planetarium has been in operation we have seen a major impact in the educational lives of Central Californians. Besides public shows, the planetarium has been open for many special astronomical events, such as eclipses, meteor strikes, and planetary transits. The local news media will come out to the planetarium for interviews when any sort of astronomical event captures global interest. All of this attention allows us to maintain relevance in the minds of the public.

SII - 142 Matthew Huber, Rhodes College, *Multi-parameter analysis of bladder mechanical properties using ultrasound bladder vibrometry*

Bladder wall mechanical properties are important indicators of bladder compliance. This study compares the effectiveness of the

Kelvin-Voigt, Maxwell, and fractional Kelvin-Voigt rheological models in capturing the mechanical properties of normal (compliant) and aberrant (non-compliant) ex-vivo pig bladder walls. Bladders were filled to different volumes, varying their thickness and internal pressure, and excited by the acoustic radiation force. Pulse-echo ultrasound imaged anti-symmetrical Lamb waves traveling along the bladder wall. Two-dimensional Fourier analysis generated velocity-frequency dispersion curves for the Lamb wave propagation. Fitting these experimental curves against theoretical curves from the models yielded values for bladder elasticity and viscosity. Pressure, measured simultaneously, was used as a point of comparison with elasticity.

Our findings indicate an increasing trend in both elasticity for the rheological models and recorded pressure with increasing volume. This rate was observed to be significantly higher in aberrant bladders than intact bladders for the Maxwell and fractional Kelvin-Voigt models (p-value of 0.0082). Additionallyall three models showed a similar strong correlation (greater than 0.9) between pressure and elasticity.

These findings provide a foundation for selecting an appropriate bladder wall rheology model which can potentially be used in evaluation of human bladder mechanical properties. [Work supported by NIH grant DK99231].

SII - 143 Felise Bloodgood, California State University Fresno, *STEM Teaching*

The purpose of STEM teaching is to allow skilled teachers in a field of science, technology, engineering, or mathematics to educate youths in their chosen field. Very few Americans have chosen to go into these fields and the result is that there are very few skilled teachers that can actually teach these subjects accurately and get students interested. Most students, when asked about a STEM class, state that they dislike or hate it. This is usually because they didn't understand the subject and or had a teacher that did not have a background in the STEM class they were teaching. Society is placing increasingly more emphasis on students getting a STEM degree and job. The United States's economy revolves around mathematics: accounting, economics, functions and logarithms, and calculus. Innovations in Medicine are created by the study of chemistry and biology. The automobile industry deals with mathematics, applied physics, and engineering. It's almost impossible to find a part of society that does not, deal with STEM subjects. However, there are a very small amount of teachers in this nation that have enough experience and skill in their subject that they can teach their students well and keep them interested in the subject matter. STEM is essential to our education system and without an adequate pipeline of STEM teachers, the future of the United States's economy, science programs, medical research, and automobile industries, just to name a few, will be uncertain.

SII - 144 Ty Carlson, High Point University, *Developing an Autonomous Toy Vehicle Using Computer Vision Techniques for Obstacle Detection and Avoidance*

A serious concern with autonomous vehicles is how to insure they are capable of going where they are intended while avoiding obstacles in their path. Our goal was to turn an ordinary remote control car into a self-driving autonomous vehicle using various computer vision methods. This was achieved by installing a Raspberry Pi and a small USB camera onto a remote control car. The Python computer language and a library of computer vision functions imported from Open Computer Vision (OpenCV) were use to analyze images and send commands to the car. Multiple strategies for obstacle avoidance based on computer vision techniques will be presented. First, the case in which a vehicle follows a target object while avoiding predefined obstacles is based on the behavior of electrical charges. The vehicle and its target are represented as opposite charges and will attract each other as a result. Obstacles are represented by the same charge as the vehicle, causing the vehicle to be repelled by these obstacles on its path toward the target. The second case deals with obstacles that have not been predefined and focuses on the use of optical flow to detect the displacement of pixels between consecutive images. Optical flow can detect and differentiate between objects that are close to the vehicle from those that are farther away. This method allows the vehicle to identify a wider range of objects as obstacles.

SII - 145 Carlos Caballero, Lamar University, *Active Flow Control and other Efficiency Maximizing Technologies in Aerospace Applications*

This report takes a brief look at the current status and future possibilities of different aerospace technologies from Avionics to Biomimicry. The goal is to suggest ways for improving the overall efficiency of the next generation of aerospace vehicles. We will focus, in particular, on the potential fuel savings generated by the use of an Active Flow Control (AFC) system on aircrafts. The fundamental concepts and principles from this exiting technology will be reviewed and the experimental data gathered with our in-house setup will be reported. First, we will explain how Air Drag Reduction could be achieved using modified surfaces particularly for aircraft's wings through an AFC system consisting of a network of sensors and actuators. Next, we will analyze the results obtained from the experiments which involved the use of a MARK-10 Series M3-5 force meter for measuring the load experienced by various material samples, such as cardboard, hardboard, aluminum, titanium, and carbon fiber, when exposed separately to air flows aimed at different angles toward the surface. Finally, conclusions drawn from our experimental observations made thus far and suggestions for future research in AFC, as well as other technologies, will be provided.

SII - 146 Blake Smith, University of Mississippi, *An Experimental Geophysical Approach to Optical Mineralogy*

This experiment measures the Verdet constant for three different samples of fluorite whose different colors are thought to correspond to different minor impurities. The measured values will then be compared to the standardized value for pure fluorite (Weber, Marvin J. Handbook of Optical Materials. Boca Raton: CRC, 2003. Print). The objective of this experiment is to check whether trace elements are responsible for the deviation in Verdet constant from standardized values.

The faraday effect gives us the following linear relationship; this equation is used to calculate the Verdet constant. $\theta = v B L$ where, θ = rotation, v = Verdet constant, B = strength of the magnetic field, L = length of the fluorite crystals."

SII - 147 Emily Brown, North Carolina State University, *Developing Software Tools to Explore the VLITE Image Archive*

Identifying transient astronomical sources gives insight into the changing universe and helps gain understanding into the nature of supernovae, gamma ray bursts, and supermassive black holes. The Very Large Array Low band Ionospheric and Transient Experiment (VLITE) uses the Very Large Array radio antennae to observe the sky in the low radio spectrum (<1 GHz) as a secondary observer while primary observations are carried out in other radio frequencies. The goal of this project was to improve numerical methods of transient source detection in VLITE images. This was accomplished by developing software in the Python programming language to explore the VLITE data archive, identify quality metrics, and empirically map the VLITE primary beam. Programs were also developed to identify known astronomical sources by developing Python code to compare VLITE catalogs to sky survey catalogs.

From 36566 images from 2014-Nov-25 to 2016-June-30 with total time-on-sky of 6540 hours and 396 805 low noise sources criteria were identified to determine likely transient candidates. This resulted in filtering out 99.997% of sources as best candidates, and set an average of 2 sources per day meeting these conditions. This is a reasonable amount for manual human inspection for determining whether the source should be designated a transient candidate."

SII - 148 Gage DeZoort, University of Virginia, *Anomalous Signal Reduction in the CMS ECAL Trigger*

Of the millions of collisions/s produced by the Large Hadron Collider (LHC), only ~1000 events/s can be stored offline. The proper classification of events within the Compact Muon Solenoid (CMS) Experiment's trigger system is therefore crucial in performing standard model measurements and searching for new physics. Occasionally, hadrons produced in the LHC's p-p collisions strike the CMS Electromagnetic Calorimeter (ECAL) barrel APDs, directly ionizing the silicon within them. This process is observed to cause false isolated signals, or spikes, that correspond to a high apparent energy in the detector. The rate of ECAL spike occurrence is proportional to the current LHC luminosity, as well as the number of charged tracks. Therefore, as the LHC pushes into more energetic regimes, these anomalous signals must be removed from the trigger decision. In order to identify and mitigate spikes, a full emulation of the ECAL L1 Trigger was constructed. In our studies, we tuned specific parameters of this L1 emulation in order to study the identification and reduction of anomalous signals, as well as their impact on the trigger rate.

SII - 149 Carlton Drew, University of South Florida, *Novel Approaches to the Magneto-Optical Kerr Effect and Other Optical Phenomenon*

Optical physics today stands on the brink of revolutionary discoveries that may change the bounds of human knowledge and capabilities forever. Outlined here are a few of the research investigations of optical phenomenon taking place at the University of South Florida, among which are the Magneto-Optical Kerr Effect (MOKE) and Photonic Crystals. Included are details of their potential applications, the mathematical formalisms used in their exploration, and the use of simulations; particularly, results from the Computer Simulation Technology's Studio Suite will be discussed and displayed. Other interesting optical research topics will also be mentioned, including optical turbulence and light fidelity. While these topics are generally understood within the scientific community, their extension to new avenues of research is emphasized.

The presented research and experiments are ongoingas are the developments of their novel applications so firm conclusions are unfortunately outstanding. However among these novel studies is the simulation of a new geometry of the MOKE experiment. The Magneto-Optical Kerr Effect is the rotation of light's polarization after reflection from the magnetic domains of a material. The new geometry produces an amplification of the Kerr rotation by trapping incident light in a cavity in which at least one wall is magnetized. Thus the continuous reflections in the cavity sum to a drastic change compared to the incident light's polarization. Future commercialization of such research could miniaturize the technology and apply it to optical communication networks involving polarization modulation schemes."

SII - 150 Michael Dunia, California State University, Fresno, *Applications in Medical Physics*

The principles of physics are seen in various aspects of medical diagnoses and treatments. One example that encompasses many physics principles is the diagnosis and treatment of cancer. Basic (classical) physics principles such as torque, force, E&M and wave theory are used in the construction of many types of diagnostic and therapeutic equipment. In addition, the more complex (sometimes relativistic) principles, such as Bremsstrahlung (x-ray production), photo electric effect, positron emission and more complex magnetic/electric interactions are also utilized in some of the more complex diagnostic and therapeutic equipment.

In this presentationI will dissect some of the common types of diagnostic equipment used in hospitals today and demonstrate how these machines operate using the basic principles of physics we learn today. Lastly I will dissect a more complex therapeutic device, a medical linear accelerator, much of this technology requires complex computer-assisted control and analysis of the data

SII - 151 Kelvin Ch'ng, San Jose State University, *Machine Learning Phases of Strongly Correlated Fermions*

Machine learning offers an unprecedented perspective for the problem of classifying phases in condensed matter physics. We employ neural network machine learning techniques to distinguish finite-temperature phases of the strongly-correlated fermions on cubic lattices. We show that a three-dimensional convolutional network trained on auxiliary field configurations produced by quantum Monte Carlo simulations of the Hubbard model can correctly predict the magnetic phase diagram of the model at the average density of one (half filling). We then use the network, trained at half filling, to explore the trend in the transition temperature as the system is doped away from half filling. This transfer learning approach predicts that the instability to the magnetic phase extends to this region, albeit with a transition temperature that falls rapidly as a function of doping. Our results pave the way for other machine learning applications in correlated quantum many-body systems.

SII - 152 Xavier Gutierrez, University of Maryland, College Park, *Latent Knowledge in Online Political Communities*

The quantification of political ideology has traditionally been constrained to a one-dimensional continuum ranging from liberal to conservative, with network analyses accordingly restricted to the view that nodes exhibit one of two states. Using the Vector Space Model (VSM) from the field of information retrieval, as well as Latent Dirichlet Allocation (LDA) topic modeling on the Stanford Encyclopedia of Philosophy (SEP), I begin the inquiry of localizing users of Reddit.com in a high-dimensional space defined by concepts. By measuring the Jensen-Shannon Distance (JSD) between topic distributions of documents, one may establish a second VSM whereby documents are mapped onto a space implicitly defined by the SEP. Accordingly, one may track users' trajectory through SEP-space, which begins to illuminate how users of social media influence each other on the basis of the topics inferred by the SEP-trained topic model. This methodological framework becomes especially relevant to political theory in light of Jurgen Habermas's model of deliberative democracy, which places specific, normative requirements on the feedback loop between the media system and civil society, which will be represented by corpora composed of news sources and the r/politics forum, respectively. The work of empirically finding discrepancies between this theory and political reality is begun with this research.

SII - 153 Maria Stone, San Jose State University, *Characterization of the "Fluffy" and Dark Galaxies of the Local Universe*

Recently a new type of galaxies, Ultra-Diffuse Galaxies (UDG) have been discovered by van Dokkum et al (2015) in the Coma Cluster. They are as large as our own Milky Way galaxy, but have a very low surface brightness. As an imaginary observer on a planet in such a galaxy, your night sky view would harbor very few stars. A follow-up study by Koda et al (2015) showed, these are not rare; the examination of the archival Suprime-Cam images of the Subaru Telescope revealed a 1000 Coma UDGs. These galaxies hold a significant amount of dark matter. There are several possible explanations for their formation.

First we look at the different Catalogs of galaxies from Local Galactic Clusters to identify the basic properties (positionsmagnitudes sizes) of such galaxies. We then analyze this data by plotting via Python and by comparing them to other members of the galactic cluster. Then as it is hard to resolve individual stars in such galaxies, we employ stellar population modeling to obtain more insight into the age and the metallicity of these galaxies. We also use GALFIT to separate the UDG from its background, the computer models so that we can contribute towards understanding their origin and the evolution of galaxies in general."

SII - 154 Leah Weston, CSU Sacramento, *SETI Observations of a Wide Field Near the Wow Locale with the ATA*
The Wow! Signal has has garnered a lot of attention, particularly in mass media since its discovery in 1977 by Ohio State University with the Big Ear radio telescope. With the Allen Telescope Array (ATA), we search for radio signals coming from the direction of the original Wow! Signal. We centered our observations at 1419 MHz with a bandwidth of 13 MHz, covering the same frequency the Wow! Signal was found at. At this time, roughly ten hours of data has been processed. The goal is to observe and process 100 hours worth of data.

SII - 155 Mohammed Alfadhel, Suffolk University, *Structural Behaviour of DNA Under an STM*
The DNA is a molecular assembly of protein blocks known as nucleotides. The dielectric nature of the DNA as a whole and its nucleotides gives it the ability to be polarized when placed in an electric field, and thus, to experience forces enough to deform its structure. In this research, the DNA is hydrated and put under quantum tunneling microscopy apparatus (STM). The STM then scans the DNA and record the dimensions of the water coating around the DNA which reflects the shape of the DNA and its nucleotides in the electric field created between the needle and stage of the STM. Now, we do the same thing over and over and build up a database of the dimensions and capacitance of each nucleotide in different orientation and in between different neighboring nucleotides in an electric field. Studying and analyzing this data will, then, allow us establish a more complete description of nucleotide behavior in such set-up which is often used in sequencing DNA. Meaning, this research will potentially help increase the accuracy of DNA sequencing processes.

SII - 156 Angelica-Lorraine Lee, San Jose State University, *Experimental and Theoretical Examinations of Compact Elliptical Galaxies, Using the IRAF-DS9 and Illustris*
Compact Elliptical Galaxies (cEs) are galaxies without a definitive identity. While there are currently select attributes known to cEs that permit astronomers to narrow down a formal definition for cEs, several of these aspects of cEs are not exclusive to them; ergo the likelihood of cEs being classified as other types of galaxies, persists. In distinguishing which of these traits are unique to cEs by means of the compilation and analysis of literature, in conjunction with the inspection of new cE candidates, the aim is to refine the current understanding of cEs. Using the Image Reduction and Analysis Faculty (IRAF) paired with the Smithsonian Astrophysical Observatory's DS9 (SAOImage DS9), photometric examination of images taken by the Subaru Telescope can be made; for instance, the range of Full-Width Half Maximum values gives rise to patterns in the effective radii (Re) of the cEs. Literature values for magnitudes of the cEs will also be used as a precedent in this method. Another commonly used tool to study the formation and evolution of galaxies within the cosmic structure in the universe is numerical simulations. The Illustris simulation by Vogelsberger et al. is a hydrodynamic simulation that simultaneously recreates the time evolution of both the dark matter and baryonic material within the cosmic structure, in great detail. The data from Illustris is exceptionally realistic and can be accessed directly online or using a web-based API. Examining and comparing both theoretical and experimental data from these methods will allow for a better understanding of cEs.

SII - 157 Luke Conover, University of the Sciences in Philadelphia, *Point Contact Spectroscopy of Iron PNictide: Effects of Sample Carrier Design and Fritting on the Conductivity and Observable En*
Multi-band superconductors, such as the iron pnictides, can exhibit multiple energy gaps depending on the crystal growth conditions and on which tunneling directions are made accessible by the sample fabrication process. The gaps are often anisotropic with respect to the crystal lattice, with some gaps predominantly conducting parallel or perpendicular to the c-axis of the lattice. Using point contact spectroscopy (PCS), it is possible to measure the energy gaps along the axes simultaneously at low temperatures. We describe our progress in measuring the energy gaps of iron pnictide single crystals (K-doped Ba-based 122 family) using PCS, discussing the effects of our soft point contact carrier design, contact size (effective resistance through the junction) and electrically tuning the point contact region using fritting techniques.

SII - 158 Iman Ahmed, Howard University, *Nanoparticle Fabrication using Gold Dewetting and Chitosan Nebulization*
Gold nanoparticles of uniform size and chitosan nanoparticles were fabricated for future applications in drug delivery. We developed a new technique for the formation of periodically arranged Au nanoparticles using a holed substrate and nebulized dissolved chitosan. Using electron beam lithography and deep reactive ion etching, the SiO2 layer on a silicon substrate was etched to create an array with cubical holes. Thin 20 nm thick Au films were thermally deposited on Si/SiO2 patterned substrates using CVC High vacuum magnetron sputterer then heated in controlled gas ambient quartz tube furnaces at 900 degrees Celsius. Particles formed were observed through SEM imaging and analyzed to obtain average particle area. Gold film thickness affected the size of nanoparticles formed in relation to grid box sizes: the ideal film for medium sized grid with cross-sectional area of 0.81 µm2 was 20 nm. To fabricate chitosan nanoparticles, ultrasonic nebulizer with sealed fan was elevated to the mouth of an 88 cm straight copper pipe with a collection slide placed within. A weak vacuum is used to draw nebulized mist to collection slide. Three Chromalox heating strips were secured to the copper pipe, powered by three variable AC power transformers, heating the pipe. Initial attempts at creating chitosan nanoparticles yielded splattered liquid aerosol droplets containing acetic acid and chitosan. However 1.0% chitosan in 0.1 M acetic acid solution allowed for chitosan particles to be successfully collected at 125¡C.

SII - 159 Angelina Gallego, Hampton University, *"Look at that Membrane!" Understanding the Interactions Between Colloids and Lipid Stabilized Interfaces Using DNA*
Every cell in the human body contains a membrane that separates inside from outside. The cellular membrane also executes a wide variety of other notable functions, from transport of nutrients to sensing and responding to the outside environment. These functions are carried out by membrane proteins, which cannot act alone and need to organize into intricate structures to function. However, the process by which membrane proteins self-assemble remains unknown. We have made progress developing a model system to study self-assembly of membrane bound objects. We use an emulsion of water and oil stabilized by phospholipids as our model 'cell,' and polystyrene colloidsÑ micron sized plastic beads Ñas our model 'proteins.' Unlike real proteins, the colloids are large enough to be imaged with an optical microscope, yet small enough to still exhibit Brownian motion. Lastly, we use DNA hybridization to induce attractive interactions between the particles and the membrane: DNA strands grafted to the particles can bind to complementary DNA strands inserted in the membrane. This results in an adhesive interaction that is chemically specific and tunable: by changing the temperature only a few degrees, we can switch the interaction from very weak to effectively irreversible. Preliminary experiments suggest that we can organize particles on a model membrane and we anticipate that our unique approach might ultimately help shed light on how objects organize on cell surfaces.

SII - 160 Tracy Edwards, Hampton University, *Analysis of Anisotropy in Drosophila melanogaster Embryo Germband Retraction*
Drosophila melanogaster is a valuable model organism in studying cellular mechanics during embryonic stages. Fruit fly embryos

undergo the process of germband retraction during the transition in the Larvae stage. Inside of the embryo contains two types of epithelial cells. The germ band and amnioserosa. During this process, the germ band curves around the amnioserosa as it reduces in size until it completely dies off, while the germ band moves to cover the dorsal side of the embryo. The amnioserosa is a vital part in the germband retraction because lack there off cause the retraction to be incomplete and for the embryo to die. The changes in the germ band shape are due to an internal and external force that drive vertical elongation. As we study the balance of anisotropy in during this stage, we hope to show its changes over time as germband retraction takes place.

SII - 161 Fatima Al-Quaiti, St. Mary's University, *Analysis of Random Alloy Nanoparticles as Catalysts for Oxidation Reduction Reactions*

Fuel cells utilize the energy produced by an oxidation reduction reaction (ORR). This reaction is favorable due to the ease at which molecular oxygen and hydrogen are obtained and the product of the reaction, water, is environmentally friendly. The reaction rate for this reaction is very slow, deeming the reaction obsolete for the large-scale production of energy, hence a metal catalyst, such as platinum, is used. Because platinum is costly, a cheaper and more efficient catalyst must be developed to make fuel cells a more economically favorable source of energy. Alloying can be used to create catalysts that are cheaper and tunable, which makes them more efficient because their activity can be altered. This research was performed using computational methods. Simulations can be used to model the binding of oxygen to the catalyst. Molecular dynamics can be used to test the stability of the binding material and catalyst structure at extreme temperatures. In this experiment, activity was measured at the (111) hollow points of the catalysts. This was done by modeling a 38-atom nanoparticle in which the atoms consisted of a 50/50 ratio of two metals to predict the ideal combination of metals.

SII - 162 Maurice Roots, Hampton University, *Synthesis and Characterization of Aqueous Silver Nanoparticles*

Silver nanoparticles can be synthesized in a number of ways ranging from green synthesis to microwave irradiation, utilizing various reducing and capping agents in all methods. This work focuses on the size controlled synthesis of silver nanoparticles (Ag NPs) using conventional heating methods. Aqueous Ag NPs were produced using silver nitrate, sodium borohydride, and trisodium citrate purchased from Sigma-Aldrich. Sodium borohydride was used as the primary reducing agent while, trisodium citrate was used for its dual function of reducing and stabilizing of the silver nanoparticles. The Ag NPs were characterized for their optical properties with UV-Vis Spectroscopy. The plasmon resonance peaks of these particles were used to give an estimate of the average size range. Size determination of Ag NPs samples were also done using a Transmission Electron Microscope. Further work will focus on seeded growth of silver nanoparticles using microwave irradiation.

SII - 163 Najma Thomas, Spelman College, *The Patterns of Light Diffraction*

For years, scientists and engineers have been using the process of light diffraction to determine the structure of objects such as biological molecules and crystalline structures. In this study, I will be using light diffraction to analyze the patterns of diffraction formed from a single helix structure and a single strand structure. Once I determine the patterns from these two structures, I can then compare and contrast the specific aspects of each pattern such as the frequency of the bands in the pattern projected or the thickness of the bands and use that to determine the overall structure of the object.

SII - 164 Hussam Ibrahim, Augustana College, *Automated microscopy platoform for high-throughput analysis of cellular characteristics*

Existing microscopy platforms allow analysis post-hoc, but not in real time. This is an issue in the world of Bioengineering because you are limited to performing further analysis on specimen. The aim of my research was to design a sophisticated system whereby information can be exchanged between the software which acquires images and software that analyzes the images immediately after acquisition. In this system, images would be acquired by the microscope and analyzed by customized scripts (MATLAB, Mathworks) in real time. Specifically, MATLAB would wait for new images to be saved on the hard drive, import these images, and perform image segmentation Ñ that is, identify individual cells. This system would be essential for many applications; rare cancer cells could be further monitored or perturbed ontogenetically. Moreover, a fluorescent protein can be further examined based on brightness and photostability as a proof-of-principle that you can image multiple modalities, and can distinguish, at a single-cell level, between cells that express different fluorescent proteins.