Ammar Abu-Halawa
Coe College

Title: A 3-Dimensional Dosimeter with Machine Learning Capabilities

Session #: 1

Poster #: 58

Every modern radiation therapy method, whether it uses linear accelerator, gamma knife, or proton beam, requires dosimetric verification of the treatment plan and treatment delivery. To fulfill this need a water equivalent (density 0.97 g/cm 3), radiation hard scintillator was designed for use in a novel three-dimensional dosimeter system. The scintillator is a radiation-hard plastic, developed with a peroxide-cured polysiloxane base, doped with the primary scintillator p-terphenyl and the secondary scintillator bis-MSB. A three-dimensional dosimeter prototype, with a unique geometry, was built and its performance was simulated at Coe College laboratories. The 10cm x 10cm x 5cm prototype was tested with an X-ray beam at the Ohio State University (OSU) Radiation Oncology Department. The detector geometry consists of 64 scintillating bars. However, the Geant4 simulation studies also used a model with bars split into 512 cubes. The simulation of 6-20 MeV electron and X-ray beams were used alongside the test beam data to develop an Artificial Neural Network (ANN) that predicts the 3 dimensional dose distribution within the body. This study summarizes the research on developing the material, prototype design, simulation and ANN dose reconstruction studies.

Yarelis Acevedo
University of Puerto Rico Mayaguez

Title: Design and development of a tensile test machine for stress and strain on carbon fiber for CMS Phase II Pixel Detector

Session #: 1

Poster #: 149

The CMS Phase II pixel detector will use Carbon Fiber for the mechanical structure (called Dees) to populate the sensors and the cooling structure. The detector will provide the 3D space information for the vertices and particle tracks to a precision of few microns. Therefore it is important to characterize the strain in Dee's structure due to the stress that may be caused y thermal changes or other mechanical stress. For a precise measurement of the stress and strain on Carbon Fiber a tensile stress machine was designed and built.

Mario Alberto
Cleveland State University

Title: Thermally Induced Aggregation Behavior of a Six-Armed ELP Star Polymer

Session #: 1

Poster #: 29

Elastin-like polypeptides (ELP) are biopolymers that form thermoreversible aggregates above a certain transition temperature (Tt). It is important to note that this temperature is not a static property of the system, it changes with the concentration of ELP. A six-armed ELP star polymer has been formed by incorporating ELP chains on both sides of a trimer forming peptide (foldon) originally found in a virus. Here we present initial data for characterizing the thermal transition behavior of a six-armed star polymer The Tt values were measured as a function of concentrations for two different ELP chain lengths. We show that these data fit well to a model developed by Meyer and Chilkoti1. Further analysis using a modification of the model that considers the polymer chain volume2, allows the geometry of the aggregating polymer chains to be estimated by the value for the scaling of chain volume with polymer length. Dynamic light scattering was used to further investigate the ELPs as they aggregate.

Daniel Allspach
Siena College

Title: Detecting Exoplanets with The Breyo Observatory

Session #: 2

Poster #: 109

Siena’s Breyo Observatory began operations in September of 2018, with the primary function of using its 0.7m telescope to provide a gateway for students into the fields of observational astronomy and astrophysics. Starting in February of 2019, the Breyo Observatory began collecting data on Hot Jupiters in an effort to begin detecting extrasolar planets. Utilizing transit photometry and a list of known transiting exoplanets, we are in the process of developing observational methods for making detections and establish the limits of the Breyo Observatory’s 0.7m telescope. Expanding on this, we present two light curves of successful transit detections and discuss methods for optimizing future observations.

Connor Ames
Missouri Southern State University
Title: PHOTOCURRENT MEASUREMENTS IN ZINC OXIDE NANOWIRES
Session #: 1
Poster #: 52

We report the photoconducting and photo-excitation properties of Zinc Oxide (ZnO) nanowire devices and explore the variations in their opto-electrical properties with modifications in nanowire density, wavelength of light (650 nm, 532 nm and 405 nm), laser intensity, channel length and substrate temperature. Nanowire devices were fabricated with multiple nanowires in between the electrodes and studied for charge transport under ambient conditions. Low-cost device fabrication techniques were adopted in this study to provide electrical contacts to multiple ZnO nanowires on glass substrate. Experimental results demonstrated the deviation in opto-electrical properties due to variations in nanowire parameters and the light source. Our research further focusses on increasing nanowire photoconductivity by altering the work function of metal contacts and surface modification in nanowire with metal nanoparticles thereby enhancing photocurrent due to surface plasmon resonance. Here we present our experimental findings on charge transport in ZnO nanowires and discuss the outcome of our results.

Sylas Anderson
University of San Diego
Title: Filament Rigidity Vies with Mesh Size in Determining Anomalous Diffusion in Cytoskeleton
Session #: 1
Poster #: 141

The diffusion of microscopic particles through the cell, important to processes such as viral infection, gene delivery, and vesicle transport, is largely controlled by the complex cytoskeletal network – comprised of semiflexible actin filaments and rigid microtubules – that pervades the cytoplasm. By varying the relative concentrations of actin and microtubules, the cytoskeleton can display a host of different structural and dynamic properties that in turn impact the diffusion of particles through the composite network. Here we couple single-particle tracking with differential dynamic microscopy to characterize the transport of microsphere tracers diffusing through composite in vitro networks with varying ratios of actin and microtubules. We analyze multiple complementary metrics for anomalous transport to show that particles exhibit anomalous subdiffusion in all networks, which our data suggest arises from caging by networks. Further, subdiffusive characteristics are markedly more pronounced in actin-rich networks, which exhibit similarly more prominent viscoelastic properties compared to microtubule-rich composites. While the smaller mesh size of actin-rich composites compared to microtubule rich-composites plays an important role in these results, the rigidity of the filaments comprising the network also influences the anomalous characteristics that we observe. Our results suggest that as microtubules in our composites are replaced with actin filaments, the decreasing filament rigidity competes with increasing network connectivity to drive anomalous transport.

Dalton Anderson
University of Wisconsin - River Falls
Title: Hysteric axial motion of aerosol droplets
Session #: 2
Poster #: 22

Optical traps have numerous applications including the study of aerosol droplets. It has been observed that in a single beam optical trap, micro-meter sized aerosol droplets exhibit hysteric axial motion in the direction of beam propagation. Two meta-stable positions have been observed and it is thought that the cause of this motion between positions may be due to morphology dependent resonances (MDRs). For this to occur, thermal expansion of the droplet from a varying laser beam power must occur. Using Cavity Enhanced Raman Spectroscopy (CERS) we can investigate the size of the droplet as the position of the droplet and the laser power varied.

Kennedy Anderson
High Point University
Title: High Point University Rocketry: Lucid Nonsense, a 2019 IREC Rocket
Session #: 2
Poster #: 73

The purpose of this project is the development, design, and full integration of a student-built rocket for entry into the 2019 Spaceport America Cup 10k SRAD competition. This rocket, Lucid Nonsense, is made with a combination of commercially available parts and student-manufactured parts. The nose cone of the rocket is an aluminum tipped fiberglass nose cone from Madcow Rocketry. The main aeroframe is made from 2 mm thick reinforced blue tube with 1.75 cm thick plyboard cross bracing. Our fins are made from hand-sanded 0.75 cm baltic birch plywood. The SRAD aluminum motor casing measures 98 mm in diameter and 26 inches in length. The casing contains 4 BATES grains of SRAD “Black Velvet” propellant which has demonstrated a total thrust of 6260 N*s (M1060). The payload is a proof-of-concept fluid dynamics project that aims to analyze how combustion influences the sloshing of liquid in a fuel tank during a rocket launch. HPU rocketry has set long term goals of developing a liquid propelled rocket for competition which will present new engineering challenges. With the data from this payload, we hope to design liquid fuel tanks with baffles to reduce liquid fuel oscillation and thus reduce combustion instability.

Ryan Armbruster
Saint Joseph's University
Title: OXYGEN BINDING IN PERFLUOROCARBONS - AN NMR STUDY
Session #: 2
Poster #: 4

Perfluorocarbons are carbon-fluorine molecules of increasing interest in biomedicine. In the 1980’s, perfluorocarbons evoked curiosity due to their biological inertness, extreme stability, and high amounts of oxygen they can sequester. The medical community sought to use these materials as a possible non-hemoglobin oxygen carrier for trauma and neonatal medicine. In recent years there has been a resurgence in perfluorocarbon research concerning the application of perfluorocarbons as a contrast agent to increase the application of 19 F MRI technology and as a delivery system of O2 to cancerous regions. We seek to explore the physics and chemistry of how these perfluorocarbons “bind” molecular oxygen. To approach this question, nuclear magnetic resonance (NMR) spectroscopy was used to study the physical attributes of the perfluorocarbon-oxygen “bond.” Since molecular oxygen is paramagnetic, its effect on the spin-lattice relaxation time (T1) and the spin-spin relaxation time (T2) of the 19 F nucleus was measured. These characteristic times reflect the environment of the 19 F, and provide information on the 19 F-O2 interaction. The T1 and T2 relaxation times of perfluorodecalin and Perflubron were measured both oxygenated and deoxygenated to evaluate the effect of oxygen concentration on their relaxation times. In general, the relaxation times were significantly decreased in the oxygenated samples with respect to the deoxygenated samples, signaling an interaction between the 19 F nucleus and molecular O2. Work is commencing on relating these data to structural differences between the two states.

Tiahra Aviles
University of Puerto Rico Mayaguez
Title: A study of the electrical properties of V2O3 thin films grown by DC Magnetron Sputtering to measure its Hall Effect.
Session #: 1
Poster #: 21

Vanadium sesquioxide (V2O3) is an attractive pseudocapacitive material for electrochemical supercapacitors that has its MIT approximal from 150 K to 162K. It was first discovered in 1946 and has received much attention by theoreticians and experimentalists. The purpose of this investigation is the development of a methodology for the consistent reproduction of V2O3 thin films to study its electrical properties efficiently. The objective is to measure the Hall Effect on V2O3 thin films, since there is no data presented on literature. The films were deposited on SiO2 by DC magnetron sputtering, studied before and after the post-deposition thermal treatment consistent with equilibrium temperature and oxygen pressure conditions for V2O3. Its crystal structure was evaluated using X-Ray Diffraction (XRD) and its morphology was characterized using Atomic Force Microscope (AFM). Gold contacts were grown by the E-Beam Evaporator on the V2O3 thin films to measure its conductivity in a cryogenic probe station, where its electrical properties were determined by measuring resistivity as a function of temperature and the Hall Effect of V2O3 thin films.

Colleen Baldwin
American University
Title: The Early Orbital Evolution of Mars in the Young Solar System
Session #: 2
Poster #: 91

Recent data shows a strong indicator that the planet Mars’ effective temperature is low, and due to the lower Solar luminosity at early times, the effective temperature would have been lower still when Mars was young. Modeling by other researchers shows that raising the temperature of Mars through maximal greenhouse gas effects may not suffice to explain the inferred temperatures on Mars. Using REBOUND, a N-body code, we aim to successfully model and study the early orbital evolution of Mars in the young Solar

System. The models will explore the interaction of the young Mars with the original asteroid belt, assumed to be more massive and dense then it is currently. Also, the models will explore whether dynamical orbital evolution through scattering of nearby planetesimals would suffice to explain the discrepancies in the inferred effective temperature, specifically through secular evolution of Mars' eccentricity in the early Solar System

Rachel Barron
Wheaton College
Title: Using time-sequenced LiDAR for the Recording of Individual Stratigraphic Layers
Session #: 2
Poster #: 38

Light detection and ranging (LiDAR) has been used for high-precision, high-density, 3D data collection. This application of LiDAR tracks the change in landscape over several weeks in an archaeological excavation site. The archaeological site is challenging due to the large blind spots on the Velodyne Ultra Puck (VLP-32) and the close, small features in the site. The raw data from the VLP-32C is processed through simultaneous localization and mapping (SLAM) and georeferenced from fixed points outside the excavation area. The challenge lies in tracking the change in these small details since much of the testing of SLAM has been done in urban or indoor settings. The archaeological site contains rich non-urban data and stratigraphic layers. To see this data, we developed a custom subtraction algorithm and daily scans are compared to create a point cloud of every mass of material which has been removed during the day. Since these changes have taken place under the direction of experienced archaeological supervisors, each mass of material has already been identified and electronically tagged in the Online Cultural and Historical Research Environment (OCHRE) database. By linking these point clouds to the OCHRE data, this process allows each mass of dirt (whether debris layer or architectural element).

Chandler Bass
University of Utah
Title: Understanding Energy and Mass Distributions of the Galaxy Cluster Abell 2199
Session #: 2
Poster #: 70

Using data from the Chandra X-Ray satellite, we have constructed surface brightness, temperature, and mass profiles of the galaxy cluster Abell 2199. I work under professor Daniel R. Wik, who is studying the energetics of merging clusters near shock front and cold fronts.

Matthew Becker
University of the Sciences
Title: Modeling Electrical Parameters in Digital Microfluidics Devices
Session #: 1
Poster #: 88

Lab-on-a-Chip (LOC) platforms not requiring pumps, tubes, or valves can be implemented by using digital microfluidics (DMF). DMF is a technique for manipulation of droplets using electric fields, which potentially allows faster chemical reactions when compared to conventional fluid handling due to the increased surface-to-volume ratio of droplets. DMF has found applications in the studies of nucleic acids, proteins, cells, and tissues. One major problem is the adsorption of droplet constituents to surfaces (biofouling), which hinders droplet motion. Despite the complexity of the phenomenon, we noticed that electric fields, required for motion, also produce a force component that pushes the droplet against the surface. Arguably, this might favor biofouling. Here, the main objective is to determine the magnitude and direction of forces acting on a droplet in DMF. Starting from the basic electrowetting geometry, simulations using COMSOL Multiphysics were used to determine electrical parameters of relevance. We will show results of the electric potential variation, the associated electric field, and their dependence with frequency. The long term goal is to arrive at an experimental design that would reduce fouling, leading to a fully controlled DMF platform working with droplets of any liquid.
We thank the Lindback Foundation for financial support.

Devin Becker
DePaul University
Title: Populating the Black Hole Mass-Gap with Stellar Collisions in Dense Star Clusters
Session #: 2
Poster #: 139

Over the past few years, the groundbreaking detections of gravitational wave signals from merging binary black holes (BHs) by LIGO/Virgo have ignited immense interest in how these sources form. Dynamical formation of binary BHs in dense stellar environments like globular clusters has emerged as an important formation channel. Dynamical interactions in globular clusters present opportunities to form binary BHs with properties that cannot be produced through classic evolution channels. For example, in a cluster environment, heavy BHs can form through runaway collisions of massive stars before BH formation. This motivates us to examine formation pathways for heavy BHs in globular clusters. In this study, we build a detailed collisional history of BH progenitor stars in globular clusters through the use of an N-body simulation code. We find that collisions of massive stars can indeed lead to the formation of BHs at or above the single stellar evolution limit, including intermediate-mass BHs. Such heavy BHs in star clusters likely acquire a companion BH, possibly becoming loud and detectable sources of GWs.

Alexander Belliare
Siena College
Title: The Breyo Observatory
Session #: 2
Poster #: 112

Siena College boasts the largest telescope in the New York State capital region, and the fourth largest in the state as a whole. The Breyo Observatory's telescope has a 0.7m diameter main mirror and CCD imaging, and soon will have optical spectroscopy. With these features, the telescope has taken many beautiful pictures of many celestial objects, both at the observatory itself and through remote control. Since its construction ended towards the end of last year, the observatory has hosted multiple public viewing events, as well as plenty of opportunities for student research. Some of these opportunities have led to the detection of exoplanets and much more.

Cassandra Billings
Siena College
Title: Exploring Large-Scale Cosmological Structures Using Computational Astrophysics Tools
Session #: 2
Poster #: 105

Detailed observations as well as computational models can reveal how galaxies have formed and evolved over the 14 billion-year history of the universe. We use new, deep observations of massive galaxies at the centers of galaxy clusters and comparisons to state-of-the-art hydrodynamic simulations to trace the stellar mass assembly of galaxies in massive dark matter halos. We also present our work on making our analysis software more portable and accessible to others using Docker containers.

Emily Branson
Abilene Christian University
Title: E1039 Luminosity Monitor Testing and Installation
Session #: 1
Poster #: 112

E1039 will collide a 120 GeV unpolarized proton beam from FNAL with hydrogen and deuterium targets polarized transversely to the beam. Then, asymmetries of dimuon pairs produced in the Drell-Yan process will be measured to find the Sivers Function, a transverse momentum dependent parton distribution function. A non-zero measurement of the Sivers Function implies orbital angular momentum of the quark sea. In measuring these asymmetries, variances in beam luminosity must be accounted for, as changes in the beam could skew our data. For this reason, E1039 is outfitted with a luminosity monitor for measuring beam intensity and accuracy. The monitor is composed of four hodoscopes on an aluminum rail and is installed in the target cave at 90 degrees relative to the beam line. The testing and installation of this beam will be presented.

Mitchell Braun
Siena College
Title: Obtaining A Constant Magnetic Field in a Solenoid, Through the Manipulation of it's Gradient
Session #: 2
Poster #: 61

Nuclear Magnetic Resonance is predominantly described by the gradient, produced by a specific magnetic field (B). Therefore, since Nuclear Magnetic Resonance requires a constant magnetic field, we have decided to develop a strategy to accurately and efficiently measure each value associated with the gradient within a double-wrapped solenoid. Specifically, we have employed the use of the Apple Iphone App-store Library in order to convert the device into a sensitive gaussmeter. As a result, the device is now capable of

precisely measuring the quantities, [d/dx,d/dy,d/dz], present within the gradient, thus allowing us to insure a constant magnetic field (B) inside the solenoid. Moreover, in order to manipulate these slopes, we utilized both End-Coils and Trim-Coils to adjust each individual component of the gradient while passing the phone through the solenoid at different positions both longitudinally and transversely at the mid-point of the solenoid. Through the use of both experiment and simulation, we hope to provide an efficient process for obtaining and manipulating each component of the gradient, as well as supply numerical examples demonstrating the method.

Jeremy Brents
Henderson State University
Title: Low-Cost, Laminar Flow Wind Tunnel Construction and Testing
Session #: 2
Poster #: 9

A laminar-flow wind tunnel provides the ability to observe both simple and complex aerodynamic phenomena. A small-scale (20-foot), low-cost wind tunnel was designed, fabricated, and assembled to study laminar flow and turbulence for various airfoil designs at adjustable angles-of-attack. The wind tunnel design was determined by a number of factors including the space required, the cost (limited to $5,000 or less), fabrication methods, and ease of use. An open return system was chosen to reduce construction costs. Following fabrication and assembly, testing has begun to determine the degree of laminar flow achieved by this student-created design. The motivation for the wind tunnel includes valuable educational and experimental components in both design and application.

Keaton Brewster
Abilene Christian University
Title: A Fluoride Molten Salt Test Loop for Advanced Reactor Development
Session #: 1
Poster #: 54

Creating safe, clean energy for the world has become a more pressing issue over time. The Nuclear Energy eXperimental Testing (NEXT) project is working to solve this problem through MSRs (Molten Salt Reactors). NEXT has already built a nitrate molten salt test loop, which has been used to test instrumentation. The next step is to build a Fluoride Molten Salt Test Loop (FMSTL) which will use FLiNaK salts and operate at 725o C. This new test loop will be used to test components and instrumentation devices which aid the design of a university Molten Salt Research and Test Reactor (MSRTRx). One of the main requirements is that this system operates at 725 C and can be monitored and controlled. Using a PID control system and thermocouples, we are able to control the heat of the molten salt vessel and the pipe with heat tape and ceramic mat heaters. This poster will discuss the benefits of MSRs, progress by the NEXT project, and the use of an FMSTL to further MSR technology.

Magen Bright
Henderson State University
Title: Deposition of Ice-phobic pAA Layers by Plasma Polymerization
Session #: 1
Poster #: 148

Currently, manufactured superhydrophobic surfaces are of great interest because of their potential applications, including ice-repelling aeronautic surfaces. Unfortunately, conventional methods of ice prevention are expensive and have limited effectiveness. Therefore, it is advantageous to develop a cost-effective coating that has self-healing capabilities in addition to superhydrophobic and ice phobic properties. Self-healing properties can be achieved by embedding a hydrophobe within the surface coating that can move to the surface and restore hydrophobicity if damage occurs. Polyacrylic Acid (pAA) has previously shown hydrophobic and ice phobic properties by cross-linking chains with dopamine via a catalytic method, but the limited cross-linking is believed to have reduced ice-phobic properties. In this study, we circumvent the catalytic method by using high-voltage dielectric-barrier discharge argon plasma to deposit pAA layers with L-Dopa cross-linking onto aluminum substrates. Plasma parameters are varied to find optimal cross-linking in the pAA and ice phobic characteristics. The degree of crosslinking will be measured by Fourier-Transform Infrared Spectroscopy and Raman spectroscopy. The hydrophobicity will be determined by using the contact angle hysteresis.

Joseph Brown
University of Mississippi
Title: Localizing Small Bubbles to Analyze Bjerknes Force
Session #: 2
Poster #: 76

The goal for this research is to analyze the Bjerknes force on small cavitation bubbles in an acoustic field created by a transducer. The method used uses the known buoyancy force on the bubbles to measure the primary Bjerknes force. Calculations of the buoyancy force on bubbles in the field will be made and then related to the given pressure field of the transducer. In order to do this the location of the bubble must be known at the time of the calculation of the buoyancy force. Two cameras are used to get all position values. Currently a blob analysis program (image recognition) is being developed to determine 3-D position and path of unstable bubbles in the field. Once developed, hopefully the program can be used in studying other small bubble field phenomena beyond the scope of our research.

Lena Bruno
Colorado St University-Fort Collins
Title: Machining for Brillouin Light Scattering Experimental Set-ups
Session #: 2
Poster #: 30

The Brillouin Light Set-up currently being used at Colorado State University utilizes both optical equipment and a high powered electromagnet. This combination creates the need for custom parts which I was tasked with creating. My contribution to this experiment is representative of a common intersection between engineering and physics. It was an interesting challenge to make something that met the material and space restrictions while also maintaining functionality.

Lena Bruno
Colorado St University-Fort Collins
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Miranda Bryson
Boston University
Title: CMS Muon Endcap Electronics Upgrade for High Luminosity LHC
Session #: 1
Poster #: 138

The wealth of incoming data from the proton-proton collisions at the Large Hadron Collider (LHC) allows physicists to investigate crucial issues surrounding the fundamental particles and their interactions, such as the mass value of the Higgs boson and the nature of Dark Matter. The triggering and reconstruction of muon leptons is crucial, as final states with muons often provide the cleanest signatures of new physics. The LHC will continue to increase its luminosity in the coming future. Our CMS sub-detectors must be upgraded to deal with these high rates, survive high radiation doses, and maintain their performance. The Cathode Strip Chambers (CSCs), the sub-detector system in the CMS endcap region, need upgraded detector and trigger electronics to allow for the efficient reconstruction and triggering of muons. After the CSCs are retrieved from the LHC cavern, they are refurbished and tested. During the process of refurbishment, the old electronic components are removed from the chamber and replaced with new front-end boards that feature a more powerful FPGA and digital readout. The testing process follows and the chambers undergo System Test of Endcap Peripheral Crate and Chamber Electronics, which tests the newly installed components and the function of the chamber in its entirety. After STEP testing is completed, the chambers are reinstalled on the CMS detector. This project assures the successful readout of muons in future LHC activity, which in turn facilitates the advancement of our knowledge of the fundamental nature of the world.

Amelia Buell
Coe College
Title: Further Evidence for Magnetic Flux Cancelation as the Build-Up and Trigger Mechanism for Eruptions in Isolated Solar Active Regions
Session #: 1
Poster #: 61

We examine the magnetic evolution of three eruption-producing solar active regions (ARs), one each from 2013, 2014, and 2017, using data from SDO HMI and AIA. Each of the ARs is relatively small, so that we can follow its entire development during a single disk passage, from birth by emergence through the time of the respective eruptions; the first-, second-, and third-born respectively lived 3, 6.5, and 3 days before eruption. Each AR was relatively isolated, with minimal interaction with surrounding ARs, allowing us to study each AR as an approximately isolated system. CMEs resulted from eruptions in the first two ARs, while the third AR's eruption was smaller and appeared confined. In each AR, the eruption was seated on an interval of the AR's magnetic polarity inversion line (neutral line) where opposite-polarity flux was merging together and undergoing apparent cancelation. Our results, together with an earlier pilot study of two ARs by Sterling et al. (2018), and along with recent studies of solar coronal jets, support the view that the magnetic field that explodes to produce solar eruptions of size scales ranging from jets to CMEs are usually built and triggered by flux cancelation along a sharp neutral line.

Grant Bunyard
Howard Community College
Title: Researching and Designing a Radial Wind Turbine
Session #: 2
Poster #: 50

The purpose of this research was to use the engineering design process to help provide a platform for future groups to test techniques for increasing the efficiency of radial turbines. This research is important because the world's reliance on fossil fuels is decreasing, so it is essential to realize the importance of renewable energy. The secondary purpose of this project was to see if a vertical axis wind turbine could be built at a low cost that had a similar performance to other models on the market and horizontal axis wind turbines. In order to achieve this goal the relationship between power generated by the turbine, and the RPM of the turbine was investigated as a function of wind speed. The data was then collected and analyzed in order to determine the efficiency of the turbine.

Christian Burns
Fairfield University-Physics
Title: On the Magnitude of Mixing in Submarine Canyons
Session #: 2
Poster #: 115

The continental slope, the region between the continental shelf and the open ocean, is intersected by numerous canyons. Previous studies have suggested that these canyons are regions of intense ocean mixing (Nazarian & Legg, 2017a,b). Ocean mixing is significantly driven by the breaking of energetic waves that propagate below the sea surface, also known as internal waves. Simple calculations have suggested that up to 25% of the internal wave energy budget may be lost in submarine canyons (Nazarian et al., in prep), yet no robust calculation of the magnitude and spatial distribution of canyon-induced mixing has been conducted. It is important to understand the magnitude and distribution of ocean mixing as it is responsible for sustaining Earth's ocean circulation and climate system. We constructed an algorithm to calculate the magnitude of mixing occurring in each canyon. We then compared it to the global wave energy budget to determine the percentage of internal wave driven mixing that occurs in canyons. We classified each canyon based on a high-resolution sea-floor map and then determined the incoming internal wave energy flux from a high-resolution tidal model and hydrographic data from the world ocean database. Based on these parameters, we developed a scaling based on Nazarian & Legg 2017b to calculate the energy loss in each canyon. We then integrated over the global ocean to find the magnitude of canyon-induced mixing and the spatial distribution to determine the significance of this mixing.

Michael Cairo
William & Mary
Title: Measuring Kappa 0 in Polarized He3 Target Cells
Session #: 2
Poster #: 10

This work involves He3 polarimetry to isolate the constant Kappa0. A cylindrical cell containing a mixture of He3, and gaseous Rb and K is polarized using circularly polarized light. The cell is centered between Helmholtz coils to produce a steady uniform magnetic (B) field. The electron parametric resonance (EPR) frequency of the cell depends on the strength of the magnetic field in the cell. The polarized He3 nuclei produce an additional B field that changes the EPR frequency. The direction of He3 polarization is invariant, so measuring the EPR frequency at two different orientations allows us to isolate the change in B field due to the polarized He3. The isolated polarization of He3 can be used to find Kappa 0, which is a constant that relates the EPR frequency shift to the cell's polarization.

Noah Callinan
Grove City College
Title: Studying the Glass Transition via Second Harmonic Generation in Dye-Doped Polymers
Session #: 1
Poster #: 67

Despite decades of research, current techniques, such as dielectric relaxation spectroscopy and differential scanning calorimetry, have failed to fully illuminate the precise nature of the glass transition in polymeric materials. Examining the pressure dependence of the glass transition may yield a deeper understanding of the phenomenon. We are investigating the use of an optical technique for measuring the pressure dependence of Tg in dye doped polymers using second harmonic generation and in-situ alignment of dopant molecules via an electric field.

Quinn Campagna
College of William & Mary
Title: Beam Modulation for PREx-II
Session #: 1
Poster #: 101

The goal of PREx-II is to measure the neutron radius of 208Pb to a precision of 1%, the original proposed goal of PREx-I. This is done by scattering polarized electrons off of a lead target, taking advantage of the parity-violating nature of the weak interaction. The difference in the scattering cross section for each helicity state allows us to extract the neutron radius of the nucleus. There can, however, be helicity-correlated beam asymmetries that are not related to the weak interaction. In order to extract these errors, we modulate the beam energy and positions, and constructing a matrix equation of the responses from the position and current monitors.

Wyatt Campbell
Angelo State University
Title: Processor Design on a Field-Programmable Gate Array
Session #: 2
Poster #: 82

The information age is centered around the microprocessor. AN early commercial microprocessor, the Intel 4004, hit the markets in 1971. Soon after, the 70's exploded with 8-bit microprocessors that could count up to 255. More recently, Field-Programmable Gate Arrays (FGPAs) have been introduced into the market. FGPAs consist of a massive grid of programmable logic gates connected via input/output circuitry. The structure of the logic gates allow FGPA functions to be programmed at any time, providing a more flexible platform than traditional integrated circuits. These FGPAs allow architecture designers to program hardware in higher-level hardware description languages (HDLs), speeding up the hardware prototyping process significantly for some applications. This research project was aimed at designing an 8-bit processor for the Xilinix Artix-7 FGPA. The chip was ordered on a Digilent Basys 3 prototyping board. The processor design was created with high-level code in the HDL Verilog using Xilinx's Vivado design environment.

Lee Ann Capistran
University of Texas Rio Grande Valley-East
Title: The Mapping of LoFASM's Radiation Pattern
Session #: 2
Poster #: 121

The Low Frequency All Sky Monitor (LoFASM) is a collection of antenna arrays that operate in the frequency range of 10-88 MHz. The primary goal of the 5 LoFASM sites across the nation is to detect and study astronomical radio signals at these low frequencies. Each LoFASM station is a synthetic aperture phased array with a fixed radiation response pattern aimed upward in order to minimize noise from transmitters on the surface, and although LoFASM's radiation pattern has been simulated, it has yet to be confirmed. The LoFASM team plans to map the radiation pattern by placing a white noise generator into an enclosure mounted on a drone. The drone will then fly over the LoFASM station and the data taken will then be used to provide a more accurate representation of the station's radiation pattern in comparison to the one that has been simulated.

David Carcamo
Johns Hopkins University
Title: On-Chip Superconducting CPW Directional Coupler
Session #: 2
Poster #: 119

A design is presented for a 20db co-planar waveguide (CPW) directional coupler optimized to work at superconducting temperatures. The motivation for this design is to build a directional coupler from first principles that utilize the superconducting physics available at these temperatures. This would reduce the thermal energy introduced into the cryostat from the electrical input into the system. The results of our design and experiment show that it is possible to design a coupler to work in superconducting temperatures.

Benjamin Carlson
Grove City College
Title: Binarity of the RR Lyrae Variable Star XX Andromedae
Session #: 1
Poster #: 12

Although nearly half of all known stars exist in binary systems, only one RR Lyrae (RRL) out of tens of thousands has been confirmed to belong to a binary system. RRLs are a type of pulsating variable star which are often used as standard candles when calculating Galactic and extragalactic distances. Binary companions to these RRLs could affect their observed brightnesses, causing inaccuracies in distance calculations. In a recent study by Kervella et al. (2019), the Hipparcos and Gaia DR2 surveys were analyzed for RRLs possessing a noteworthy proper motion anomaly, suggesting a possible binary companion. We select one of these identified RRLs, XX Andromedae, and perform further photometric observations to assess its possible binarity. We proceed by supplementing our new observations of XX Andromedae with past archival data to search for light-time travel effects, as indicated by periodic patterns in the residual (O-C) plot, that could reveal evidence of a companion star.

Herminio Carrillo
Cal State Sacramento
Title: Off-axis Short Gamma-Ray Bursts and their Afterglow properties
Session #: 2
Poster #: 59

Short gamma-ray bursts (sGRB) are among the most energetic phenomena in the Universe. Since the recent discovery of both gravitational and electromagnetic waves from a neutron star merger referred to as GW170817, sGRBs have become extremely important for multi-messenger astrophysical studies. sGRBs go through two important stages during their lifetime, which are referred to as the "prompt emission" and the "afterglow emission". Prompt emissions last in the order of seconds, which gives astrophysicists a narrow time frame to detect them. Afterglows can last for months, which allows us to follow them extensively and use them to infer physical parameters of the explosion and its environment. However, given that most sGRBs are not directed straight toward us, we need study the properties of sGRBs afterglows at various observer angles. It is imperative that we consider how the jet properties change as a function of the angle between the burst axis and the observer in order to garner relevant information on the nature of short gamma ray bursts as a whole.

Xiaolong Chen
University of California, Merced
Title: Parameter Search for Detecting Structural Variants in Genomes
Session #: 2
Poster #: 39

Genomic variation shared by members of the same species that are longer than a single nucleotide are commonly called structural variants (SVs). Though relatively rare, they represent an increasingly important class of variation as SVs have been associated with diseases and susceptibility to some types of cancer. Computational approaches for detecting SVs often involve parameters that describe certain relevant biological phenomena.In our work, such parameters relate the incidence of inherited and novel SVs to probabilistic models of observing these SVs. In the work presented here, we investigate the sensitivity of our computational framework to these parameters. In particular, we demonstrate the robustness of our method by identifying a wide range of parameter values that lead to high-accuracy SV predictions in simulated data.

Olivia Chierchio
Adelphi University
Title: Generation Optical Beating between Hyperfine levels in the Decay of Rb atoms Excited by Different Pulse Shapes.
Session #: 1
Poster #: 107

We are investigating quantum interference in the atomic decay signal in a dilute thermal atomic gas with an intense pulsed laser beam. A short pulse of laser light (~ 3 ns) is used to drive atoms from the ground state to an excited state hyperfine manifold of levels. We are exploring how quantum beating and other excitation properties depend on the shape of the driving frequency (e.g., cw, chirped, white-noise, etc).

Shoumik Chowdhury
Yale University
Title: Decoupling bosonic modes using sequential quantum transducers
Session #: 1
Poster #: 124

Quantum transducers are a key component necessary for interfacing between quantum systems based on different physical platforms, and will be crucial to the development of quantum networks. Previous studies have shown that by operating 2-mode transducers in sequence, it is possible to achieve perfect one-way quantum state transfer. Here we generalize this result to N > 2 modes; specifically, by operating mode converters in sequence, we can decouple unwanted bosonic modes, and so reduce a general N-mode transduction problem to the 2-mode case.

Shoumik Chowdhury
Yale University
Title: Decoupling bosonic modes using sequential quantum transducers
Session #: 2
Poster #: 11

Quantum transducers are a key component necessary for interfacing between quantum systems based on different physical platforms, and will be crucial to the development of quantum networks. Previous studies have shown that by operating 2-mode transducers in sequence, it is possible to achieve perfect one-way quantum state transfer. Here we generalize this result to N > 2 modes; specifically, by operating mode converters in sequence, we can decouple unwanted bosonic modes, and so reduce a general N-mode transduction problem to the 2-mode case.

Dakota Christian
Old Dominion University (ODU)
Title: Photoproduction with GlueX in the reaction $\gamma p \to a_2^{-} \Delta^{++}$
Session #: 1
Poster #: 137

First measurement of photoproduction reaction $\gamma p \to a_2^{-} \Delta^{++}$ is performed at GlueX in $a_2^{-} \to K^{-}K_{s}$ decay mode. The K_{s} is reconstructed in $\pi^{+}\pi^{-}$ decay mode. Almost background less (10$\%$) of invariant of $a_2^{-}(K^{-}K_{s})$ will allow for the first time test natural and unnatural parity contribution to tensor ($J^{PC} = 2^{++}$) meson photoproduction.

Liam Clancy
High Point University
Title: Into the Black Hole: HPUniverse Day and its Impact on Young Minds and a Community
Session #: 2
Poster #: 69

Once every fall semester, the High Point University Department of Physics hosts an astronomy-themed public outreach event called HPUniverse Day. More than one hundred faculty and students come together to expose local kids and their families to space, science, and beyond through twenty-five different discovery stations. Examples include hovercraft rides, water-bottle rockets, virtual reality demonstrations, planetarium shows, and many other experiments. For this past year's event, we invoked a new theme in celebration of the first resolved image of the black hole in M87. Upon arrival, kids were greeted as if they were space cadets training to explore the black hole at the center of our galaxy. The newly enlisted cadets started at the World of Physics station where they learned about basic physics that could help them later in their training. Volunteers from the biology, chemistry, and education departments then provided insight into searching for and analyzing life on exoplanets, using robotic technologies for conducting research, and building new space colonies. Additionally, the cadets learned how to navigate across the surfaces of different exoplanets using hovercrafts designed by our students and faculty. Getting closer to their final goal, the cadets conducted test launches with simple rockets and blasted off towards the center of our Galaxy. Finally, the cadets were immersed in a thrilling video about black holes and the science behind them in the new Culp Planetarium. HPUniverse Day enhances the collaborative nature of our physics department, while also strengthening the bond between our university and the surrounding community.

Oguzhan Colkesen
Davidson College
Title: Structural Properties & Metal Distributions on Abell 754 and Abell 520
Session #: 2
Poster #: 143

Clusters of galaxies are one of the brightest X-ray resources in the universe. They give pieces of evidence for the questions: how the universe is expanding, how matter is distributed in the space, as well as how gravitational waves are produced. The main X-ray emission from cluster of galaxies is coming from hot gas at the intergalactic regions at the clusters. Consequently, X-ray structural analysis of these galaxy clusters show the behavior of this hot gas between galaxies. In this study, Chandra X-ray analysis of two clusters of galaxies is presented. The observation data are retrieved from NASA's HEASARC database with observation IDs of 9426 and 10743 for Abell 520 and Abell 754 respectively. Ciao 4.7 tool for Chandra X-ray Observatory is used to perform the analysis. The X-ray images are modified using DS9 software, which are presented in soft, medium, and hard X-ray bands, and spectral analyses of the clusters are done with XSPEC tool of HEASARC. Line emissions for X-ray spectra of Abell 520 and Abell 754 are produced and studied separately to reveal the metal distribution of hot gas in the intergalactic medium of the clusters of galaxies, which is presented for both Abell 520 and Abell 754. X-ray images and spectral analyses show that it is correct to make the assumptions that Abell 520 is a merging clusters of galaxies and Abell 754 is close to hydrostatic equilibrium.

Kevin Connors
Grove City College
Title: Binarity of the RR Lyrae Variable Star AT Andromedae
Session #: 1
Poster #: 25

As a class of variable star, RR Lyrae (RRL) stars serve an important role as standard candles for Galactic and extragalactic distance measurements. However, binary companions could affect the observed brightness of RRLs, causing distances computed using their luminosities to be erroneous. While a majority of stars in the Milky Way belong to binary systems, only one RRL out of tens of thousands has been confirmed to be part of a binary system. The recent study by Kervella et al. (2019) employs the Hipparcos and Gaia DR2 surveys to identify numerous RRLs possessing a notable proper motion anomaly, suggesting a binary companion. We select one of these stars, AT Andromedae, and perform further photometric observations to assess its binarity. We proceed by examining the light curve maxima of AT And, combining our data with past times of maxima to look for periodic patterns in the residual (O-C) plot caused by light-time travel effects, which could reveal evidence of a companion star for AT And.

Thomas Cope
Juniata College
Title: Accessing CCD camera characteristics for exoplanet observations
Session #: 1
Poster #: 109

Exoplanets are planets that exist outside our Solar System. Over 4,000 planets have been discovered but only around 50 of them are earth sized and in the Habitable Zone, or where life can exist around a star. Some scientists estimate that there are as many as 40 billion earth sized and possibly habitable planets in our galaxy alone. The aim of this research is to use modest astronomy equipment and methods to produce precise light curves of Earth-sized exoplanets, and more deeply analyze CCD cameras and their characteristics to achieve better light curves. Once this can be achieved, the goal is to join the TESS follow up project to contribute to their project by following up on new exoplanets. We are using a 16-inch telescope with a CCD camera with an adaptive optics unit attached to capture images for analysis. To thoroughly test the CCD cameras, a black box with a small LED light source and variable apertures was used to measure the noise characteristics.

Max Coplan
Towson University
Title: Beyond the Black Hole Horizon with Mathematica
Session #: 1
Poster #: 70

Black holes are real, as recently proven by radio images of M87. But the interiors of these objects remain mysterious. They are unobservable by definition, and can only be explored through theory and simulation. Mathematicians have shown that the shape of spacetime inside the event horizon is characterized by at most seventeen "curvature invariants", functions of space and time whose value is independent of the choice of coordinates. We have developed a Mathematica code to compute and plot all these invariants for black holes of the most general kind (those with mass, charge and spin). We outline the physical motivation, describe the coding challenges that had to be overcome, present the resulting plots, and discuss some of the implications.

Dillion Cottrill
WVU Chapter of the Society of Physics Students
Title: Spin-Selective Energy Level Modification via the AC Stark Effect in a Quantum Dot
Session #: 2
Poster #: 103

Applying a strong laser far detuned from the resonance of a charged quantum dot causes an AC Stark shift of the energy levels, where the magnitude and direction of the shift is dependent upon the polarization, detuning, and intensity of the laser. The polarization also determines which spin manifold is shifted with circular polarization shifting only one spin projection. There is also a secondary energy shift, which is very likely caused by dynamic nuclear polarization, or the transfer of spin polarization from electron to nuclei, manifesting itself in the form of the Overhauser effect. In principle, the AC Stark effect in a Voigt geometry magnetic field will allow read out of the spin state of a quantum dot. *Research supported by the U.S. Department of Energy, Office of Basic Energy Sciences, Division of Materials Sciences and Engineering under Award DE-SC0026848.

Justin Craig
Millikin University
Title: Classifying Supernovae of the Dark Energy Survey
Session #: 1
Poster #: 36

Dark energy is an unknown form of energy that is described by Einstein as “vacuum energy” or the energy of space. By acting as a “standard candle,” Type Ia supernovae (SNIa) provide a unique opportunity to study dark energy. Classifying supernovae (SN) as SNIa was traditionally accomplished by analyzing SN spectra, but the large number of observed SN by the Dark Energy Survey (DES) prevented collection of spectra. So, two di?erent machine learning classi?ers (SuperNova Identi?cation by Random Forest (SNIRF) a random forest classi?er; SuperNNova (SNN) a recurrent neural network) were developed to accurately and quickly determine SNIa from photometric data. Both classi?ers were developed to analyze the full ?ve-year data set collected by DES as well as the eventual data to be collected by the future Large Synoptic Survey Telescope (LSST) project. To determine which classi?er should analyze the collected data, the performance of both classi?ers were tested based on di?ering sizes and compositions of simulated data sets. SNIRF only required an equivalent of two DES seasons of data to become trained. Even with non-optimal training sets, SNIRF was able to provide over .98 precision at a .95 recall rate. However, SNIRF required supernovae light-curve ?tting results which prevented the classi?cation of SN with minimal data. SNN, unlike SNIRF, can use raw photometric data without light-curve ?tting, but through the performance testing, SNN required ?fty times more training data than SNIRF to be just as accurate and e?cient.

Alicia Cronkhite
University of Texas-Rio Grande Valley West
Title: Women in STEM Programs
Session #: 2
Poster #: 67

Using community ethnobiographies done with females of the Rio Grande Valley, we look at implicit and explicit bias in STEM Education and how we can help change teacher and faculty expectations. Growth mindset is an important factor in changing existing opinions, so how can we support our faculty to look at these new ideas?

Brian Cruz
University of Puerto Rico - Mayagüez Campus
Title: Physics Community
Session #: 1
Poster #: 3

The University of Puerto Rico - Mayagüez Campus has many associations with physics at its center, and each has brought their passion to the public. We have the Society of Physics Students (SPS), Sociedad Meteorológica de Puerto Rico (SMPR), which is affiliated to the American Meteorological Society (AMS), the Optical Society of America (OSA), the Scientific Software Club (SSC), and Students for the Exploration and Development of Space (SEDS).

Matthew Cruzan
Missouri Southern State University
Title: Europa Timeline : Ordered by Mission Date
Session #: 1
Poster #: 44

Life on Europa – A review of interesting facts and recent findings Matthew Cruzan and Daniel B Marsh Chemical and Physical Sciences, Missouri Southern State University, Joplin MO The possibility of finding extraterrestrial life forms has increased interest in the search for places that may have an environment capable of sustaining life. This search extends from the surface of Mars to newly discovered exoplanets of other stars within a possible habitable zone for that star. In recent years, researchers have observed that moons of gas giant planets appear to have regions which are capable of sustaining life. In addition, studies in our own oceans indicate that life forms such as those found around volcanic vents are capable of surviving in even harsher conditions than previously suspected. Similar harsh but survivable conditions may exist within one of Jupiter's moons. At this time, strong evidence supports the case that Europa may have salty oceans located deep beneath the icy crust making Europa the next place to look for the possibility of life. Here we present prominent studies on Europa’s oceans and the search for life on this Jovian moon.

Carmen Cuestas
Towson University
Title: New Classroom Demonstrations in Introductory Electromagnetism and Modern Physics
Session #: 1
Poster #: 47

Classroom demonstrations can help students better visualize and retain abstract concepts in electromagnetism and modern physics. We describe the development and implementation of two inexpensive examples, both built and tested by students: one that uses electromagnetic railguns to demonstrate the reality of the electromagnetic field through the force it exerts on a current-carrying projectile, and the other that uses a low-power laser, beam splitter, high-speed photodiode detectors and an oscilloscope to measure the speed of light in a small classroom. Student appreciation of the latter is heightened by using dry ice or chalk dust to reveal the laser beam as it traverses both the long and short paths from the beam splitter to the detectors

Keith Dabroski
Grove City College
Title: Binarity of the RR Lyrae Variable Star XX Andromedae
Session #: 1
Poster #: 23

Although nearly half of all known stars exist in binary systems, only one RR Lyrae (RRL) out of tens of thousands has been confirmed to belong to a binary system. RRLs are a type of pulsating variable star which are often used as standard candles when calculating Galactic and extragalactic distances. Binary companions to these RRLs could affect their observed brightnesses, causing inaccuracies in distance calculations. In a recent study by Kervella et al. (2019), the Hipparcos and Gaia DR2 surveys were analyzed for RRLs possessing a noteworthy proper motion anomaly, suggesting a possible binary companion. We select one of these identified RRLs, XX Andromedae, and perform further photometric observations to assess its possible binarity. We proceed by supplementing our new observations of XX Andromedae with past archival data to search for light-time travel effects, as indicated by periodic patterns in the residual (O-C) plot, that could reveal evidence of a companion star.

Thomas Danza
Adelphi University
Title: Super-Resolution Patterns in Quantum Dots
Session #: 1
Poster #: 103

In this research, quantum dots and other materials were measured for their ability to absorb nonlinearly. Using the second harmonic of a nanosecond Nd: YAG laser an interference pattern was etched onto a quantum nanoparticle thin-film sample and a reference sample which were then compared against linear and nonlinear absorption. After one pattern was formed, a second pattern was interlaced with the first by introducing a phase shift into one arm of the interferometer. Due to the nonlinear nature of the absorption, this allows the formation of a pattern with twice the resolution possible with linear techniques. While the visibility of the combined pattern is reduced as compared to simple interference, it is still sufficiently high for many applications.

Dylan De Jesus Rodriguez
Universidad de Puerto Rico-Mayaguez
Title: Wonders of Astrophysics
Session #: 2
Poster #: 130

Astrophysics, the science beyond Earth. It studies every aspect of our Universe, from the vast void that surround galaxies, to the chaotic environment of a black hole. With the principles of astronomy, chemistry, and physics, astrophysics attempts to discover the endless mysteries, humanity has yet to uncover. Stars, galaxies, nebulas, and exoplanets, including those inside our Solar System, are just few astronomical objects investigated by astrophysicists. The birth and death of stars, the diverse amount of planets, the astonishing beauty of spiral galaxies, and the dark energy that forces our Universe to expand are phenomena that make astrophysics one of the most wonderful branches of physics.

Joseph Dees
Henderson State University
Title: Design and Manufacture of a Minimally Invasive Underwater Remotely Operated Vehicle
Session #: 1
Poster #: 27

As much as can be learned about lake habitats using satellites, shipboard sensors, and divers, these technologies have their limitations. Over the last few decades, engineers have developed submersible technologies capable of meeting the many challenges of exploring our freshwater lakes and rivers. The purpose of this project is to design and build an underwater remotely operated vehicle (ROV) as a minimally invasive underwater research platform for use on local lakes and waterways. ROVs are remote control underwater robots driven by an individual on the surface. These robots are tethered by a series of wires that send signals between the operator and the ROV. All ROVs are equipped with a video camera, propulsion system, and lights. Other equipment is added depending on the specifications required. These include a manipulator arm, water sampler, instruments that measure clarity, light penetration, temperature, and depth. As the depth of these bodies of water can vary from as little as two feet deep to as deep as two hundred feet, it is essential that the vehicle be able to navigate no matter what depth the water may attain. Through the integration of a Raspberry Pi, Pixhawk, Low Light HD Camera, and 6 T200 motors, the ROV will adaptable to provide a platform for

a variety of research uses. The end goal of being capable of being used by a large variety of researchers to monitor and investigate underwater environments, habitats, and species.

Diyaselis Delgado Lopez
University of Puerto Rico Mayaguez

Title: Strain gauge measurements of carbon fiber Dee for the CMS Phase-2 Upgrade of the Tracker Forward Pixel Detector

Session #: 1

Poster #: 2

The silicon sensors of the TFPX are mounted on a carbon fiber structure called "Dee", due to its shape; it experiences deflection, upon thermal expansion and contraction of the material, and that deflection is measured by a strain gauge using a Dee prototype upon an applied load. The project entails the selection of a design for a strain gauge experiment to measure deflection and failure in carbon fiber used in the Dee. Based on the acquired data, a material profile for carbon fiber is used as a guideline for the Dee's construction and modeling as part of the Phase-2 Upgrade of the Forward Pixel Detector from the CMS Experiment.

Justin Dickovick
Fairfield University

Title: .Analysis of Electro-Scattering Off a Deuteron Target

Session #: 2

Poster #: 34

.One of the biggest questions in physics at the moment is: what is the quark structure of the nucleons that make up the matter that we are familiar with? Specifically, can we describe the measurable characteristics of nucleons in terms of their most basic building blocks? These quark structures can be described using Generalized Parton Distributions, or GPDs. GPDs can be studied by looking at electron scattering on nucleons and nuclei resulting in the production of a real photon, the scattered electron, and the nucleon. Jefferson Laboratory, a medium energy particle accelerator laboratory in Newport News, VA, has a large experimental program devoted to studying Deeply Virtual Compton Scattering. Jefferson Lab has been collecting data of protons and deuterons using an electron beam of energy 10.2-10.6 GeV. In this poster, I will present the procedure and preliminary steps towards analyzing JLab data on deuterons. From a programming point of view, I will show how a Java code was developed to read the data files and how data were filtered to isolate the channel of interest. Using detector information and principles of energy and momentum conservation, I was able to perform analysis on deuteron data.

Siddharth Diwan
Oakridge International School

Title: Exploring Light Echoes in Astronomy

Session #: 1

Poster #: 135

Clumps of matter located near luminous astronomical objects can reflect a fraction of the light incident on them. The reflected light travels a longer path compared to a direct light ray, on its way to an observer far away. Therefore there is a delay in the arrival time of the reflected ray. A wide variety of astronomical systems exhibit such delays in their light curves, ranging from broad-line clouds near active galactic nuclei, to X-rays reflected by accretion disks near black holes and neutron stars, to ejected shells by supergiant stars like V838 Monocerotis. Here we present a python code to study the distribution of light delays created by reflection due a circular disk. We assume a point source of light at the origin and an observer at infinity whose direction cosines are user inputs. The user also provides the disk's radius and the x,y,z coordinates of its center. The plane of the disk is parallel to the xy-plane. We use our code (publicly available at: http://dmaitra.webspace.wheatoncollege.edu/light-echoes/) to study histograms of time-delay distributions due to different disk geometries as well as different disk/emitter/observer configurations. Future versions of the code will include added features such as the ability to alter the disk's orientation with respect to the observer, and generating time-delay histograms for an ensemble of disks scattered around the source, e.g to realistically mimic a broad-line region near an active galactic nucleus.

Samuel Dobson
Henderson State University
Title: Ethanol Emissions From E&J Gallo Winery in Fresno, CA
Session #: 2
Poster #: 1

This research examines the impact wineries may have on designated "disadvantaged communities" in California, using ground-level whole air samples collected upwind and downwind E & J Gallo Winery in Fresno, California. These samples were analyzed using gas chromatography and a variety of detectors to determine the quantity and identity of dozens of gases. Elevated ethanol levels were found downwind of the winery. These levels alone are not concerning; however, the products of atmospheric ethanol oxidation may create problems. Ethanol oxidation creates acetaldehyde, which can increase the levels of ozone and secondary organic aerosols. Forward wind trajectories indicate that these emissions typically travel south through San Joaquin Valley through disadvantaged communities. These regions already experience issues like poverty, poor water quality, and health issues the addition of gases from the winery could have negatively affect health and quality of life for locals in this area, especially over a lifetime. Although the concentrations were not above toxicity thresholds for these gases, there are hundreds of wineries scattered throughout these disadvantaged communities, and these levels might be even worse later in the year when grapes are processed. Emissions during processing are predicted to be much higher than what we have presently found. These ground samples will be compared to NASA SARP 2019 and NASA/NOAA FIREX-AQ mission flight samples that will hopefully capture emissions during this grape processing period. A comparison will be drawn between policymakers' calculations and observed emissions. Currently this research examines what impact wineries may have on California's disadvantaged communities.

Jonathan Dodway
Siena College
Title: Analysis of H? Distributions of Group Galaxies
Session #: 2
Poster #: 116

Many galaxies in high-dense regions, including clusters and groups, have shown reduced star formation rates (SFR). There are possible environmental mechanisms that can affect the interstellar-medium and stars within a galaxy, however which interactions dominate has yet to be determined. Semi-Analytic Models (SAM) are known to over-exaggerate the efficiency of these mechanisms that quench SFR, so new findings can be used as better constraints for SAM. We use H? imaging to quantify the amount and extent of H? emission as a tracer of SFR. Here we present enclosed fluxes and radial surface brightness plots for a sample of galaxies in the galaxy groups MKW7 and MKW8.

YuXin Dong
Purdue University
Title: Constraining the Progenitor Systems of Calcium-rich Transients
Session #: 1
Poster #: 6

Calcium-rich (Ca-rich) transients are a newly recognized class of supernovae (SNe) with peculiar characteristics. They have a de?ning feature of strong calcium line emissions thirty days after explosion and may be a signi?cant driver of chemical evolution in the intracluster medium. Presently, the progenitor systems of Ca-rich transients remain unclear. Their early and late time spectra are very similar to core-collapse (Type Ib/c) supernovae. However, because some events occur in the outskirts of their often elliptical host galaxies, it is widely believed that Ca-rich transients are connected to thermonuclear (Type Ia) SNe. The possibility of mixed populations i.e., a combination of Type Ia and Type Ib/c SNe contained in the class, has not been ruled out. Here we present a detailed stellar population characterization of the host galaxies of all 17 known Ca-rich transients using broadband photometry from ultraviolet to infrared wavelengths. Our analysis is done using Prospector, which specializes in stellar population inferences. We ?tted the spectral energy distribution of each host galaxy and calculated physical parameters including stellar population mass, star formation rate ratios, metallicity and constructed the star formation history (SFH) of their host galaxies. The results put robust constraints on the progenitor population and provided evidence for potential diversity in their progenitor systems.

Johari Dramiga
Texas Lutheran University

Title: Developing a Python-based Computational Model for Photoluminescence from a single, strained InGaAs/GaAs Quantum Well.

Session #: 1
Poster #: 123

An empirically obtained relationship, the Varshni Equation, has been successfully used to model the temperature dependence of photoluminescence for most bulk semiconductor materials. However, for quantum wells, the model does not show good agreement with observations in many cases. Using python, the photoluminescence emission of a single, strained InxGa1- xAs/GaAs quantum well has been modeled. The model accounts for variations in x (In mole fraction) in the alloy material, and differences in the temperature dependence of the lattice constant in each material, to determine the compressive strain present in the well layer. First order elastic theory is used to understand the role of that strain on the InxGa1-xAs band structure. Vegard's Law was used to interpolate material parameters for the InxGa1-xAs alloy. Standard finite square well solutions are used to determine quantum confinement within the well to determine initial and final electron transition states and includes temperature dependence of the barrier and well band gaps. The model then loops through temperature steps to produce a model of the PL emission as a function of temperature. The model output was compared to experimental data for several well widths and In mole fraction and has successfully demonstrated observed subtleties in the low temperature (<30K) temperature range.

Anna Duchac
Middle Tennessee State University

Title: How Female Astronauts Have Changed the American and Japanese Astronaut Programs Through Two Case Studies

Session #: 2
Poster #: 117

This paper explores how the American and Japanese Astronaut programs have changed with the introduction of female astronauts. this is done through the use of a few case studies to show the changes to the astronaut programs. The changes brought about with each female astronaut are important to understand as they continue to affect and shape how the programs both choose future astronauts and how each mission is run. It is also important to see how the programs vary between the two countries as they have approximately the same percentage of female astronauts. It is hoped that this paper will inform the audience of the changes brought about by the inclusion of female astronauts and how they continue to shape these programs today

Marc Ebiri
Grove City College

Title: Binarity of the RR Lyrae Variable Star AT Andromedae

Session #: 1
Poster #: 13

As a class of variable star, RR Lyrae (RRL) stars serve an important role as standard candles for Galactic and extragalactic distance measurements. However, binary companions could affect the observed brightness of RRLs, causing distances computed using their luminosities to be erroneous. While a majority of stars in the Milky Way belong to binary systems, only one RRL out of tens of thousands has been confirmed to be part of a binary system. The recent study by Kervella et al. (2019) employs the Hipparcos and Gaia DR2 surveys to identify numerous RRLs possessing a notable proper motion anomaly, suggesting a binary companion. We select one of these stars, AT Andromedae, and perform further photometric observations to assess its binarity. We proceed by examining the light curve maxima of AT And, combining our data with past times of maxima to look for periodic patterns in the residual (O-C) plot caused by light-time travel effects, which could reveal evidence of a companion star for AT And.

Benjamin Edwards
Abilene Christian University

Title: Determining the Optimal Atlas Size for Machine Learning Auto-Segmentation Using Staple and Random Forest Algorithms for Head and Neck Medical Images in Elekta Admire

Session #: 2
Poster #: 21

In radiation oncology, a tedious part of treatment and research is contouring the anatomical structures in medical images. Using auto-segmentation, we can unload some of this tediousness onto a computer for greater time efficiency. Using a set of human contoured images, machine learning algorithms can draw their own contours on different patient images. The more atlases, generally, the better the machine learns. In this study, the effectiveness of the machine is measured in this study by the DICE similarity coefficient of the computer's contours compared to an oncologist's (gold standard). On a graph of number of atlas images against the DICE coefficients, the DICE will plateau after a certain number of atlas members. The goal of this study is to find the fewest number of images we can have in an atlas before the plateau.

Samuel Ehrenstein
Case Western Reserve University
Title: Mangrove vs. Non-Mangrove Classification Utilizing High-Spatial-Resolution UAV Imagery
Session #: 2
Poster #: 111

Mangrove forests are incredibly important and productive ecosystems, playing vital environmental roles including sequestering carbon, reducing coastal erosion, and enriching coastal biodiversity. There are currently no effective methods for large-scale identification of dwarf mangrove species; the dominant methods for mangrove species identification involve either field measurements, which do not scale effectively to large mangrove forests, or low-spatial-resolution satellite imagery, which do not capture enough detail to effectively distinguish between species. We propose two related approaches using high-spatial-resolution imagery taken by drones, along with tile-based classification using transfer learning on pre-trained convolutional neural networks for image recognition. The first approach uses straightforward transfer learning with 256x256 px tiles (approximately 4x4 m spatial resolution), retraining the output layer of InceptionV3. The second uses 128x128 px tiles (approximately 2x2 m spatial resolution) and the convolutional layers of VGG16, but with different architechture for the fully-connected and output layers. We achieved an average of 97% accuracy with the InceptionV3-based network and an average of 98.2% accuracy with the VGG16-based network. Our next step in this research is to experiment with methods of improving the spatial resolution of our classifications, such as overlapping tiles and image segmentation.

Mario Escabi
University of Puerto Rico Mayaguez
Title: UPRM Physics Department
Session #: 1
Poster #: 94

In Puerto Rico not many Universities offer a physics bachelors with a comprehensive curriculum and ample research opportunities with professors in various fields. UPRM is one of the only ones that does offer these benefits in Puerto Rico while also having an active student body as evidenced by the amount of student organizations with different focuses within the department: SEDS (astronomy) , SPS (general physics), ASO (optics), SMPR (meteorology) and SSC (programing). Some of the fields in which researches undertaken in this department is: high energy physics, theoretical physics, radio astronomy, magneto-optics, material science, computational physics, optics and atmospherical physics. Aside from the previously mentioned the department also counts with three minors: Astronomy and Astrophysics, Atmospherical sciences and Meteorology; and Physics.

Caroline Evans
Davidson College
Title: Are the brightest coronal loops always rooted in mixed-polarity flux?
Session #: 1
Poster #: 28

Abstract not available

Kevin Fernando
University of Central Florida
Title: Development of nonlocal Green-Kubo formalism with applications to coupled heat and mass transport
Session #: 1
Poster #: 38

Nonlocal equations for coupled heat and mass transport are developed within the Green-Kubo formalism. Nonlocal thermal transport in Lennard-Jones solids and Si is computed to establish the existence of semi-ballistic transport. The results are discussed in the context of experiments using laser-pulsed pump-probe experiments. Moreover, the expressions are used to analyze the results of molecular-dynamics simulations of single- and two-component fluids. It is shown that even in a single-component fluid, correlations between mass- and heat-flux densities can be determined by an analysis in reciprocal space with finite k. Thus, it is shown that the heat of transport for a single-component fluid can be defined and computed. Using the same approach, two heat of transport values can be established for a two-component system. This contrasts with previous studies using Green-Kubo which have only demonstrated how to compute a single heat of transport coefficient related to interdiffusion.

Manuel Ferrán
University of Puerto Rico Mayagüez Campus
Title: The SPS "Physics Show" at Mayagüez, Puerto Rico
Session #: 1
Poster #: 4

During the spring semester of 2019 at the University of Puerto Rico, Mayagüez, three performances of the theatrical play "The Physics Show: Make Physics Great Again" were executed. Born from the creativity and passion of some SPS members at Mayagüez, this theatrical play served as a means of teaching the local community about physics and its history through drama and entertainment. Packed with historical facts, physical demonstrations, and a lot of comedy, "The Physics Show" reached hundreds of people, ranging from students to children, adults, and professors alike, making this one of the most notable achievements and public engagement the SPS Chapter at Mayagüez, Puerto Rico, has accomplished in recent years.

Guillermo Fidalgo
University of Puerto Rico Mayaguez Campus
Title: Machine Learning for Data Quality Monitoring for CMS Experiment at CERN
Session #: 1
Poster #: 150

The Data Quality Monitoring (DQM) of CMS is a key asset to deliver high-quality data for physics analysis and it is used both in the online and offline environment. The current paradigm of the quality assessment is labor intensive and it is based on the scrutiny of a large number of histograms by detector experts comparing them with a reference. This project aims at applying recent progress in Machine Learning techniques to the automation of the DQM scrutiny. In particular the use of convolutional neural networks to spot problems in the acquired data is presented with particular attention to semi-supervised models (e.g. autoencoders) to define a classification strategy that doesn't assume previous knowledge of failure modes. Real data from the hadron calorimeter of CMS are used to demonstrate the effectiveness of the proposed approach.

Megan Fisher
The College of Wooster
Title: Improving Forecasting of Drivers of Severe Space Weather with the New MAG4 HMI Vector Magnetogram Database
Session #: 1
Poster #: 117

MAG4 is a space-weather forecasting tool that makes forecasts of a solar active region's (AR's) next-day chance of producing major eruptions (e.g., major flares or major Coronal Mass Ejections [CMEs]) that can drive space weather. The centerpiece of MAG4 is a pair of AR-event-rate forecasting curves obtained from (1) AR major-eruption histories and (2) an AR free-magnetic-energy proxy computed from magnetograms of the ARs. The curves used for forecasting are from MAG4's large database built from Solar and Heliospheric Observatory (SOHO)/Michelson Doppler Imager (MDI) AR line-of-sight (LOS) magnetograms. Because MDI is now defunct, to forecast a AR's major-flare rate, MAG4 presently uses the vertical-filed component of the AR's Helioseismic and Magnetic Imager (HMI) vector magnetogram to approximate the AR's MDI LOS magnetogram. Now that MAG4 has compiled a new database of AR major-flare histories and alternative AR free-energy proxies computed from HMI vector magnetograms, we quantify the improvement in MAG4's AR major-flare forecasts resulting from using the AR's HMI vector magnetogram with the pair of forecasting curves from MAG4's new HMI database instead of the presently-used pair from MAG4's MDI database. Using the Heidke Skill Score (HSS) and the statistical methods of Falconer et al.(2014), we show that this change gives for an optimized free-energy proxy (1) gives a 10-?improvement in MAG4's major-flare-forecasting performance, and (2) forecasting performance that ties or significantly exceeds that of the alternative AR free-energy proxies that are in the new database.

Ben Flaggs
University of Maryland
Title: Phase-I Upgrade of the LHCb Detector
Session #: 2
Poster #: 101

The Large Hardon Collider is currently in its second long shutdown (LS II) during which upgrades are being made to individual experiments at the collider. LHCb is one of the experiments being improved at the LHC that attempts to determine both charge-parity (CP) violation and lepton flavor universality (LFU) violation in b-hadrons. LHCb enhancements are being made to ensure that data can be collected quicker in future data runs. Specifically, the major upgrades include implementing the first software-only trigger in a hadron collider experiment and increasing the data acquisition rate by a factor of 5-10. This will be accomplished by upgrading the vertex locator (VELO), upstream tracker (UT), scintillating fiber detectors and the data collection software, where the University of Maryland is responsible for the UT upgrades. Overall, the upgrades aim to collect 10 times more data as well as 20 times more exclusive hadronic events, hence a larger abundance of data from which CP and LFU violation can potentially be determined.

Katelynn Fleming
Drew University
Title: Molecular Dynamics with NMR
Session #: 2
Poster #: 28

This poster looks into a specific property of NMR known as nuclear Overhauser effect (NOE), which manifests through cross peaks on a two-dimensional NMR spectrum when atoms within a molecule are close to each other in space. The intensity of a cross peak changes due to the molecular tumbling rate, or how fast the molecule is bouncing around within the liquid. This property, in turn, is decided by the molecular weight of the compound and the temperature of the sample. In fact, the intensity of a cross peak can change so much that it goes from positive to negative. This experiment uses a small drug molecule called Losartan and simulates increasing its molecular weight by inserting it into a solution containing a spherical detergent assembly, or micelle, called DTAB. The detergent is structured with hydrophilic heads creating a sphere and hydrophobic, carbon-chain tails gathering inside. Since Losartan is a hydrophobic molecule, it enters immediately into the assembly to escape the water solvent outside. Once theLosartan is inside, it tumbles with the whole assembly, which has a molecular weight of 17550rather than Losartan's 461. Therefore, the molecular tumbling rate slows significantly. When we look again on the spectrum, we see that the intensity of the peak has changed from positive to negative.

Paris Foster
Texas Lutheran University
Title: Fabrication and Characterization of Porous Silicon Thin Films Produced Using Non-Contact Photochemical Etching Methods
Session #: 2
Poster #: 141

A non-contact method for the production of Porous Silicon (p-Si) thin films on p- and n-type substrates were developed. In this method, crystalline silicon substrates are immersed in a hydrofluoric acid solution and illuminated by a laser source. Variations in process parameters, including process time, light source wavelength and substrate conductivity were used to investigate optical properties of the resulting p-Si films. Room temperature, Raman Spectroscopy, and Photoluminescence Spectroscopy were used for optical characterization with over 30 samples that were fabricated. Several samples exhibited film formation upon visual inspection and characteristic photoluminescence. Raman measurements confirmed the crystalline integrity of the thin film structure. The strongest luminescence was exhibited by samples processed in HF/Cobalt Nitrate solution with a broadband luminescence centered at 700nm.

Marielle Gaspar
University of Texas at San Antonio
Title: Preliminary Results of Machine Learning Model Predicting Outcomes of TRISO Particles under High-Temperature Gas-Cooled Reactor Accident Conditions
Session #: 1
Poster #: 127

Tristructured isotropic (TRISO) particles, which contain a central kernel of uranium oxycarbide (UCO) and are surrounded by a multilayered ceramic shell, are the fuel form proposed for high-temperature gas-cooled reactors (HTGRs) and very high temperature gas-cooled reactors (VHTRs). SiC, which comprises the outer most layer of the TRISO particle, has well understood oxidation kinetics in steam and oxygen containing atmospheres. However most of the data available in the literature is limited to 100% steam, pressurized steam, and wet air conditions. These next generation nuclear reactors are proposed for operation at temperatures in excess of 600°C, and though helium is the primary fuel coolant, the fuel form could see appreciable amounts of moisture, oxygen, carbon monoxide, and carbon dioxide during certain accident scenarios. The exposure to a highly corrosive, mixed gas atmosphere can impact the integrity of the fuel form, and the response of SiC to these mixed atmospheres is largely unknown. The research presented incorporates machine learning approaches, using over 1200 data points collected from the established thermodynamics of SiC-oxidant reactions and experimental data acquired in collaboration with this work to enable the prediction of the oxidation rates for SiC in mixed gas atmospheres.

Dylan Gayer
Coe College
Title: A Machine Learning Study with Proton Imaging
Session #: 1
Poster #: 60

Proton therapy has a precision capability on delivering high radiation doses on small volumes as long as precise imaging is provided. Current images on proton therapy are provided by X-Rays, which comes with 3-4% unavoidable uncertainty due to stopping power conversion tables. A compact calorimeter design, named CARNA, was introduced as a possible imaging detector that can utilize the existing proton beam for imaging purposes. This approach can exclude the errors due to the conversion tables, and lessen the radiation exposure for the patient. A novel high-density scintillating glass with ~6 g/cm3 density designed for this purpose allows CARNA to be compact enough to be attached to a gantry. The geometry using alternating bar orientations eliminates the need for trackers, and allows for the use of machine learning for imaging. In order to train an Artificial Neural Network (ANN), a tumor image library with over 200 tumor shapes was created. These tumors were selected from the Cancer Imaging Archive to create the body of this library. These tumor images have been edited to represent varying densities ranging from 0.5 to 0.9 g/cm3, ran through a simulated CT scan using Geant4, as well as a radon transformation from MATLAB. After training with this library using a regression model, the ANN can reconstruct the images of the tumors with a significant accuracy. A Convolutional Neural Network (CNN) approach was also used on the predicted images to remove the background noise and sharpen the image.

Kaleb Gebrekirstos
Juniata College
Title: What Can You do With a Physics Degree?
Session #: 1
Poster #: 106

Physics graduates have skills that are in high demand in diverse sectors such as healthcare, engineering and technology, meteorology, space and astronomy, etc. It is, therefore, no surprise that nearly 90% of physics graduates end up working in non-physics related jobs. This presentation talks about a software engineering internship and explains how one can succeed in that role by applying the numerous transferrable skills they acquire through the study of physics. Moreover, it analyzes different career paths that are especially suited for physics majors.

Emily Geist
Juniata College
Title: Comparing Galaxy Bar Strengths with Star Formation Rates
Session #: 2
Poster #: 52

More than half of all spiral galaxies exhibit a “bar” consisting of dense populations of stars moving on elongated orbits around the galaxy centers. Despite the prominence of bars, the specifics of bar evolution and their role in galactic dynamics and galactic evolution remains abstract. Galactic bars are thought to affect the star formation rates (SFRs) of galaxies by transferring angular momentum to the outer regions of the galaxy which causes gas to flow inward towards the center. Using PanSTARRS data, we measured the bar strength of 40 galaxies using isophote analysis to determine the percentage of stellar mass that resides in each galaxy’s bar. SFRs were determined by measuring the luminosity in the 22-24 micron mid-infrared. We compared these measurements for possible correlations and found a strong correlation does not exist between a galaxy’s SFR and the strength of its bar. However, the data does indicate an average range of bar strength versus SFR with a separate group of star-burst galaxies with strong bars.

Jarrod Gibson
Juniata College
Title: The Compact Grism Spectrometer
Session #: 1
Poster #: 111

Small observatories often lack funding to utilize a professional stellar spectroscopy setup. These devices are useful for observing spectra, but they cannot be used simultaneously with photometric equipment. The compact grism spectrometer offers an affordable alternative that benefits from the ability to interchange with photometric filters remotely. The grism was created in a computer design software and 3D printed, leaving only the internal optical elements in terms of price. The device was then tested in conjunction with a CCD camera to observe spectra from elemental emission tubes.

Katherine Gifford
Adelphi University
Title: Progress on the Development of a Magnetic Field Sensor
Session #: 1
Poster #: 104

This project aims to develop a magnetic field sensor by using the special properties of quantum entangled photons to intensify the sensitivity of a Faraday effect based sensor. The Faraday effect occurs when the polarization of light rotates as it passes through select materials in the presence of a magnetic field. The sensitivity of our crystals, Cd(0.57)Mn(0.43)Te and Cd(0.86)Mn(0.14)Te, can be detected at different polarizations. The introduction of a super magnet creates a measurable polarization rotation. We experimented with a variety of geometrical configurations in an attempt to maximize the rotation. In the first set up, we mounted the magnet in close proximity to the crystal. In later designs, we placed the crystal inside of the super magnet by 3-D printing a structure to hold the crystal. Once optimized, the added use of entangled-photon pairs as a source will enable us to create a highly sensitive magnetic field sensor.

Hailey Gilman
Randolph College
Title: Performing and Analyzing Alvin Lucier’s “I am Sitting in a Room” (IASAR): an Exploration of the Natural Resonant Properties of Performance Spaces at Randolph College
Session #: 2
Poster #: 142

Alvin Lucier's "I am Sitting in a Room" (IASIAR) is an experimental music composition in which a sound in a room is recorded and its recording is played back until, according to Lucier, the resonant frequencies of that room are amplified. We collected data using a modified version of Lucier's method for various sounds, including the monologue written in his score, performances in singing and flute, and pink noise. We used SciPy, MatPlotLib, and MATLAB to process the data from our resulting sound files. We seek a method to quantify our data as well as to develop a theoretical model to better understand the underlying mechanisms regarding Lucier's method. For more information on this, please find Joe Vazquez’s poster, “Analyzing Alivin Lucier’s ‘I am Sitting in a Room’ as a Potential Measure of Room Modes.” This project was funded by the 2019 Randolph College Summer Research Program.

Carissa Giuliano
Adelphi University
Title: Developing a Community Outreach Program on the Physics of Smell
Session #: 1
Poster #: 105

From the beautiful smell of roses to the harsh smell of bleach, have you ever wondered how your body is able to detect scents? How is a scent molecule—an odorant—detected, and how does it go from being detected to transmitting signals to your brain? I will present our progress toward developing a public outreach program on the physics of smell to present at local high schools and museums. Researching the sense of smell allows us to explore how science is multidisciplinary and how one process involves elements of biology, chemistry and physics. We have developed interactive exhibits to explain the two primary models that reveal how we smell: the lock and key model and the inelastic electron tunneling model. For the lock and key model, we 3-D printed several receptors for molecules, built from molecule kits, to fit into. For the tunneling model, we have developed various graphical simulations and used a physical example of frustrated total internal reflection to showcase a visible example of tunneling. After presenting this at various maker fairs our main takeaway was that observers will need to understand more about properties of light to grasp this demonstration. Therefore, we plan to incorporate a segment on this in the next version of the presentation. Developing an outreach program on the sense of smell and presenting numerous times allows us to reflect on each presentation and change it to create the most effective demonstrations, providing an opportunity for educational research.

Jelani Givens II
Knox College
Title: On the Conformally flat Weyl-Rodriguez Black Hole as a Perfect Fluid
Session #: 1
Poster #: 22

This work focused on a solution to Conformal Weyl Gravity which describes a black hole with a Petrov Classification O (the Weyl tensor vanishes), and Segre Classification [(111),1] (Perfect Fluid). A search for the conformal factor that maps the given Conformal Weyl Gravity solution on to Minkowski (flat) spacetime through a conformal transformation was conducted. An investigation of the fluid parameters that the Conformal Weyl Gravity solution possesses then followed. All while Weyl gravity was explored as an alternative theory of gravity differing from Albert Einstein's theory of gravity.

Kelsey Glazer
Towson University
Title: Testing Einstein with the 2017 Total Solar Eclipse
Session #: 1
Poster #: 53

We describe a student re-enactment of Eddington's famous test of general relativity by imaging two seventh-magnitude stars on either side of the Sun during the Great American Eclipse of August 21, 2017. Both stars were within one solar radius of the Sun, and according to Einstein's theory, their apparent positions should have shifted apart by 2.4 arcsec during totality. We traveled to Lexington, South Carolina and also made contact with other observers along the path of totality in Idaho and Oregon. Our analysis was complicated by an unexpectedly bright solar corona, but we eventually measured a deflection angle of 4 +/- 29 arcseconds, consistent with Einstein's theory.

Julia Goeks
Ripon College
Title: Effects of Sugar Concentration on Thermal Denaturation
Session #: 1
Poster #: 35

Osmolytes are small molecules which organisms use to alter water content and activity in order to stabilize protein structure. Osmolytes are used to protect cells against stressors such as heat, drought, or salinity. While several mechanisms have been proposed for how osmolytes might impact protein structure, there is as of yet no comprehensive theory which can predict the efficacy of an osmolyte. This experiment explored the effects of varying concentrations of select monosaccharides (glucose, methylglucose, myo-inositol) on the thermal denaturation of common biological proteins (lysozyme and bovine serum albumin [BSA]). Samples of constant protein concentration were evaluated via circular dichroism spectroscopy over the temperature range 15-90 °C in order to ascertain how melting temperature was affected by sugar concentration.

Carson Goettlicher
Towson University
Title: Soft X-Ray Solar Flare Time Series Reconstruction
Session #: 1
Poster #: 55

Solar flares are magnetic reconnection events resulting in sudden bursts of electromagnetic energy, particle acceleration, and hot plasma heated to over 10 MK. Hot solar flare plasma gener- ates copious soft X-rays. Hence, spectral soft X-ray measurements provide great constraints on flare plasma temperature and dynamics. Flare observations from Low-Earth orbiting satellites like the first Miniature X-ray Solar Spectrometer (MinXSS-1) CubeSat can be occulted for 30 minutes of the 90 minute orbit, missing vital portions of the temporal evolution of the spectrum and plasma. In this project, the eclipsed MinXSS-1 spatially integrated spectra from 0.8 - 15 keV is reconstructed using non-oculted data by fitting an empirical piecewise temporal-spectral function consisting of Gaussian, Lorentian, and polynomial components. This automated pro- cedure fits the original data and adds synthetic data points to the eclipse period in the temporal profile, which can be used to reconstruct the spectral profile for energy range specified in the time series. At both points of egress and ingress there are larger decreases in the low energy (< 3 keV) soft X-ray flux due to absorption by nitrogen and oxygen in Earth’s atmosphere. Results from this project could be used in future projects focusing on exoplanet atmospheres and models of flare plasma evolution.

Génesis Gonzalez
Universidad de Puerto Rico-Mayaguez
Title: Cosmic Rays Flux Studies During Solar Eclipse in Puerto Rico
Session #: 1
Poster #: 1

The main purpose of this research is to analyze the effect of a solar eclipse in detected muon flux at the surface level in Mayagüez, Puerto Rico. Four quarknet cosmic ray detectors have been stacked with the purpose of filtering muons among the shower of cosmic rays. We measured the muon flux in order to study it's variations before, during and after the solar eclipse ocurred in August 21, 2017.

Sarah Gonzalez
New College of Florida
Title: Modeling the Disk of the Milky Way Galaxy
Session #: 1
Poster #: 100

The purpose of this project is to map stars within the disk of the Milky Way galaxy. We accomplish this goal through methods of statistical photometric parallax. Potential substructure has been identified and linked to galactic wiggles, the Hercules Aquila Cloud, and the Hercules Halo Stream.

Josiah Gowen
Grove City College
Title: Prediction of Non-valence Temporary Anion States of (NaCl)2
Session #: 1
Poster #: 20

Non-valence temporary anion states are notable because they can act as a ‘doorway mechanism’ allowing low energy electron capture to drive processes which would otherwise require high temperatures or high energy electrons or photons. It is difficult to experimentally characterize these states since they have a lifetime between 1-100 femtoseconds. Computational modeling can provide accurate energies and lifetimes of these states but require using extended basis (off-atom functions) and including electron correlation effects accurately. We used equation-of-motion coupled cluster (EOM-CCSD) calculations to predict the existence of a non-valence temporary anion state for NaCl Dimer. This molecule was picked because of its large quadrupole moment which binds an electron in an Ag orbital, suggesting the possibility of temporary capture in a B2u orbital. We used the stabilization method and analytic continuation to determine the resonance energy and lifetime. As well as predicting a non-valence temporary anion state for the NaCl Dimer, we showed the effect of correlating the core electrons of alkali metals was important to accurately characterize the temporary anion state.

Anna Grafov
University of Maryland
Title: Correlating Multiphoton-Absorption-Induced Luminescence (MAIL) with Morphology in Noble Metal Nanostructures
Session #: 2
Poster #: 66

Incident light coupled with surface plasmons on noble metals results in strong localized electromagnetic field enhancement. When low-intensity, ultrafast pulses of near-infrared light impinge upon noble-metal nanostructures, highly efficient, broadband luminescence is produced. We examine the relationship between this luminescence and the geometries of gold and silver nanostructures.

Hope Greenspun
Juniata College
Title: Study of Solar Nuclear Fusion and Development of Fusion as a Future Source of Energy
Session #: 2
Poster #: 87

The development of society is inseparable from energy. As the planet's population continues to increase, so, too, must the amount of energy produced to satisfy humankind's needs. Fossil fuels are nearing exhaustion, and renewable energy sources are not sufficient enough to make the cut. The solution to future energy problems lies in nuclear fusion, a process plentiful in resources and capable of powering the planet. To fuse positively charged nuclei, the Coulomb barrier must be overcome, an obstacle that makes the development of a fusion reactor in a lab setting extremely difficult. Geared towards finding a resolution, this study investigates nuclear fusion in the Sun, a natural fusion reactor, in which fusion of 1038 protons each second converts 0.7% of their masses to energy and shines the Sun with luminosity of 1026 W. Results show that no proton within the Sun's core, which has a temperature of 1.5 keV, is capable of climbing over the Coulomb barrier; however, due to the quantum effect and a Gamow peak that is ten times lower than the barrier, these protons have a probability of tunneling through the 820 keV barrier. From Zhang's theory, the scalar field can polarize space, hence increasing the electric permittivity. This increase in electric permittivity leads to a significant enhancement of fusion reaction rate since the barrier is reduced and the tunneling probability is increased. The reaction rate enhancement may play an essential in develop lab fusion reactors and solving fusion energy problems.

Matthew Gronert
Drew University-Physics
Title: In line time of flight detector for measuring He charge state ratios
Session #: 1
Poster #: 68

A low-resolution time of flight detector (TOF) was designed and constructed to measure the ratio of different ions extracted from the Extended Electron Beam Ion Source (EBIS) at Brookhaven National Laboratory. The in line TOF allows for the determination of the charge state ratios without diverting the beam path. It is able to identify the various ions in the beam, including different isotopes. A Bradbury-Nielsen gate was used to truncate the beam in time and space, to make an effective measurement. It is highly transparent and can be left in the beam without affecting beam intensity. The in line TOF will be deployed to EBIS at BNL. It will facilitate the operation of EBIS and Extended EBIS and so will facilitate the operation of RHIC and the future eIC. In the future it will be combined with a position monitor to have more functionality. This device would be a unique design.

Jake Grove
Juniata College
Title: Astrometric Measurements of Main Belt Asteroids
Session #: 1
Poster #: 92

Most undergraduate labs are taught using the recipe process, where students simply follow a clear procedure that doesn't allow students to develop skills that are important in experimental and research settings. With this need in mind, many undergraduate programs have begun to develop opportunities that allow students to enhance this skill set. One way that instructors have implemented the above process into their undergraduate labs is research experiences for undergraduates. This project focused on determining the astrometric positions of asteroids. Observing plans were written in NotePad to be used by a 12 inch telescope equipped with a CCD camera in robotic mode. The data collected from the telescopes was analyzed using MPO Canopus and Astrometrica and were sent to the Minor Planet Center for evaluation to receive an observatory code from the International Astronomical Union. The takeaway of this research experience is the development of skills that are important to research and being able to understand how to work through systematic errors in a research setting.

Ryan Guenthner
Old Dominion University-Physics
Title: Introductory Analysis of Exceptional Points
Session #: 1
Poster #: 86

The purpose of this paper is to provide an introductory analysis of exceptional points (EP's) that arise due to coupling of physical systems. A brief history of EP's is included, followed by a discussion detailing problems where the nature of EP's is, or may be, of interest. A thorough analysis of a coupled quantum mechanical system is provided for both a Hermitian and a non-Hermitian system

in order to elucidate how the presence of an EP changes the behavior of the system. A cursory analysis of a system containing two coupled LRC circuits is also provided.

Peter Hadchiti
University of Dayton

Title: Hyperdoping Silicon For Infrared Detection and Night Vision Applications

Session #: 1
Poster #: 11

Infrared (IR) detection has many commercial applications such as in night vision and fiber optic communications. Current night vision devices are large and low-res, and can not be integrated with consumer electronics. Being able to make silicon (Si) based IR detectors would make it substantially cheaper and easier to integrate infrared imaging and other optical systems into consumer devices. The properties of silicon make it useful for electronic devices but it is not a good material for IR imaging because it does not efficiently absorb IR light. By adding impurities to Si in a process called hyperdoping, infrared absorption can be induced which could lead to Si-based low-light imaging. It has already been shown that hyperdoped silicon can detect IR light, but only at very low efficiency. Our research has been in manipulating the doping and fabrication processes to increase the efficiency of Silicon-based IR detectors. We have fabricated new photodetectors based on these improvements, and I measured the optical and electrical properties of these devices. The new devices show improvement of nearly two orders of magnitude in the infrared photoresponse from what has already been shown, demonstrating this material's potential for infrared imaging.

Kelsey Hadfield
Pacific Union College

Title: Scaling Laws Echoing Musical Harmony at the Frontier Between Atomic and Subatomic Particles

Session #: 1
Poster #: 18

Abstract: Using the neutron mass as a unit of energy, selected physical constants that include the charge of the electron, Bohr radius, Rydberg constant, and subatomic particles were scaled into dimensionless quantities. These dimensionless physical constants lie down on a straight line in a log-log plot, suggesting that they are ruled by a power law. Further geometrical analysis of the plot shows that the power that corresponds to each of these constants is a partial harmonic number ($1 \pm 1/n$). Thus, in the new unit of energy, these constants constitute the mathematical harmonic series 1/1, 1/2, 1/3, 1/4, ...1/n that rule numerous phenomena such as the musical scale notes. The harmonic pattern surprisingly applies to subatomic particles as well. We are presenting our results in this poster.

Ray Hagimoto
University of Texas at San Antonio

Title: Symmetries of CMB Temperature Correlation at Large Angular Separations

Session #: 1
Poster #: 96

New measurements are reported of the angular correlation function of cosmic microwave background (CMB) temperature at large angular separation ?, based on published maps derived from WMAP and Planck satellite data with different models of astrophysical foregrounds. Results of different techniques are compared with each other, with and without masks in the regions of largest Galactic emissions. It is found that without the measurement bias introduced by masking, most maps yield consistent values near zero at ?=90° and ?=30°, and significant negative correlation at ?>160°. It is argued that these properties are consistent with symmetries predicted in holographic quantum models of inflation, but unlikely to occur in the standard scenario.

Morgan Hale
Roanoke College

Title: Identifying Minerals On Mars Using Mössbauer Spectroscopy

Session #: 1
Poster #: 116

The NASA Mars Exploration Rover, Opportunity, used a Mössbauer spectrometer to analyze rock, dusk, and soil samples from Mars. This tool measures the energy level transitions in the nuclei of 57Fe by emitting gamma rays onto the samples using 57Co, which has a half-life of less than a year. Using a computer application, Recoil, the spectrum curves of the energy level transitions in the samples can be fitted. The values of the spectrum curves identify the different magnetic and non-magnetic minerals in each sample, as well as the abundance of each mineral. As the sol, or one day on Mars, increases, so does the scattering of the data since the

source of the gamma rays, 57Co, is aging. For the sites, or samples, with a high level of scattering that hinders an accurate spectrum fitting, published spectrum values are compared to the data in order to determine the mineralogical composition of the sample. From sol 634 to 1401, Hematite, Magnetite, Pyroxene, Olivine, Jarosite, and nanoparticles were found. Among these minerals, the finding of Jarosite, in particular, indicates past water activity because this mineral only forms when water is present.

Kathleen Hamilton-Campos
University of Maryland College Park
Title: FOGGIE: The (re-)distribution of metals in a simulated Milky Way Mass Galaxy
Session #: 1
Poster #: 15

A complete picture of galaxy formation requires a complete census of metals in and around galaxies. Metal distribution is intimately linked to star formation and gas flows in galaxies, as stars seed galaxies with metals that are then re-distributed through gas flows and feedback processes. We use an unprecedented resolution simulation to study the (re-)distribution of metals in a Milky Way mass galaxy. We measure evolution in the metal mass, total mass, and metallicity for the stars, ISM, and CGM over time. We are exploring how these results shed light on large-scale gas flows in and around the galaxy.

Jacob Hanson-Flores
University of Wisconsin - River Falls
Title: Characterizing the Phenomenon of Lane Formation in an Electric Field
Session #: 2
Poster #: 118

The concept of lane formation, often referred to as 'laning,' has been observed in both experimentation and simulation. When placed into a confined space and driven by an external force (an electric field in our simulation), oppositely charged particles will form into lanes. This phenomena is analogous to the way that pedestrians traveling in opposite directions find themselves in a natural ordered state. Historically, this research has been extrapolated with applications for traffic control. Understanding the conditions and principles under which lane formation occurs could have further application for next generation electronics.

Aiden Harbick
The College of William and Mary
Title: Computational Explorations of Temperature Dependent Dynamics in Type II Superconductors
Session #: 1
Poster #: 120

Superconducting Radio Frequency (SRF) cavities are a large topic of interest in the scientific community. In order to operate, SRF cavities are cooled by being dipped into a liquid helium bath. Experimental evidence shows that SRF cavities have better performance when they are cooled faster. To simulate this, we vary the alpha parameter in the time dependent Ginzburg-Landau equations, as it has a temperature dependence. Using this we confirm that faster cooling seems to result in less vortex nucleation, and therefore better SRF cavity performance. We then propose a new material specific formulation of the Ginzburg-Landau equations for doing more advanced simulations in the future.

Taylor Harris
University of Northern Iowa
Title: Technique Development of Finite Layer Dichalcogenides by Mechanical Exfoliation
Session #: 1
Poster #: 147

A mechanical exfoliation technique is being developed to create finite molecular layers of MoS2. This work utilizes the deposition of a thin layer of gold to enhance the method of mechanical exfoliation for a better yield of finite layer MoS2. Traditional chemical exfoliation techniques are not able to produce large scale finite layer MoS2 samples, which produce relatively small and randomly sized particles. The methodology behind finite layer MoS2 production involves the initial deposition of a 8-10 nm thick gold substrate via sputter coater onto a bulk MoS2 crystal. Thermal tape is then implemented to exfoliate the bulk crystal, flipping the sample so that the created MoS2 layers reside on top of the gold substrate. Atomic Force Microscopy (AFM) is utilized to observe substrate surface flatness as well as determine the layer thickness of MoS2 after mechanical exfoliation. Through AFM and correlation with optical microscopy, the resulting systems after exfoliation are atomically flat with lateral sizes on the order of hundreds of microns. However, AFM imaging has revealed submonolayer steps which may indicate specific interactions between the Au/MoS2 interface. Ultimately, the large scale production of finite layer MoS2 allows for ease of testing as related to its electrical and optical properties.

MoS_2 is a high mobility direct band gap semiconductor, allowing energy transition states to be more accessible as compared to its bulk counterpart defined by an indirect band gap.

Zubia Hasan
Johns Hopkins University
Title: Exotic Magnetism in CuTeO4
Session #: 2
Poster #: 74

Cuprates have been extensively studied over the past decades due to their importance in high temperature superconductivity as well as their exotic magnetic behavior. In particular, CuTeO4 seems to be a promising candidate for high temperature superconductivity upon doping. This is due to its' square lattice layer of Copper ions as well as its Cu-O-Cu bond angles which are more similar to that of Herbertsmithite than other Cuprates. To date, CuTeO4 has only been made as a secondary phase while making other Copper Tellurates. No systematic studies have been done to characterize the compound and experimental data for magnetic susceptibility as well as heat capacity have not yet been published. Here in, we report a novel method of synthesizing polycrystalline CuTeO4 as the primary phase of a hydrothermal synthesis. The compound was predicted to have a quasi-2D Neel ground state . However, the magnetic susceptibility data of the compound shows no long range ordering, but an intriguing hump around T=120K indicates some low dimensional antiferromagnetic interactions. The magnetic hysteresis curve fits Brillouin function by fixing some variable parameters like the g-factor and the total spin to a plausible value. The fit shows 1% impurity spins, explaining the abrupt upturn before T=50K. However, the heat capacity data shows no magnetic transition at T=50K. The inconsistency in the susceptibility and heat capacity data demonstrates the need for neutron scattering to unequivocally determine the magnetic structure of the compound.

Vanessa Havens
Siena College
Title: Radio Astronomy with Vineyard Trellising
Session #: 2
Poster #: 88

Vineyard Trellising can be used in Radio Astronomy in a unique way of observing the sky on a large scale radio telescope. By comparing the composition of trellising wire and the wire used in antennas, as well as how well they pick up signals, we can determine if we are able to use the parallel wires as an antenna. Implementing a specific piece of equipment known as a Software Defined Radio Play(SDR) we are able to take in the signals from two different wires and compare them simultaneously to test if we could use the vineyard trellising for the 20 MHz frequency using a similar approach as the RadioJove program. This project is a continuation from a previous summer, but focusing mainly on the implementation of a data receiver.

Robert Hawranko
Grove City College
Title: Fluorescence Quenching Analysis of the Binding of Alpha-Naphthoflavone to the Drug-Metabolizing Enzyme Cytochrome P450 3A4
Session #: 1
Poster #: 51

Human cytochrome P450 3A4 (P450 3A4) metabolizes ~ 50% of drugs on the market and prominently figures in pharmaceutical development. Here the interaction of ?-naphthoflavone (?NF) with P450 3A4 was evaluated by the quenching of the fluorescence of both ?NF substrate and the tryptophan residues of P450 3A4. Binding of aNF to P450 3A4 induces fluorescence quenching of both fluorophores. Quenching is also caused by high-energy UV photons that photobleach the fluorescence from both substrate and protein. Thus the strength of the binding interaction is erroneously inflated. To evaluate the photobleaching of P450 3A4 fluorescence, a blank buffer solution was titrated into P450 3A4 solutions (no ?NF present). The enzyme was largely resistant to photobleaching: 24% of P450 3A4 fluorescence was photobleached during the entire titration. Only 22 % of aNF fluorescence (no protein present) was susceptible to photobleaching. Photobleaching corrections for substrate and enzyme were then applied to the quenching that resulted when aNF was titrated into a solution of P450 3A4 enzyme. From a Stern-Volmer analysis of quenched protein fluorescence, a strong binding interaction of aNF to P450 3A4 was revealed. The dissociation constant was K_d = 0.333?M .

Rydia Hayes-Huer
Bridgewater State University
Title: Narrow Band Observations of the 2019 Chilean Total Solar Eclipse
Session #: 2
Poster #: 25

Studying the Sun helps us to not only understand distant stars and celestial objects, but to understand and predict the effects of solar winds on planet Earth. The Sun is our closest star, yet there remain mysteries still unsolved by Solar Physicists: the coronal heating problem and the mechanisms responsible for the fast/slow solar winds. Total solar eclipses (TSE's) offer us an opportunity to study the Sun's corona and gather data to help solve these mysteries. For the 2 July 2019 TSE, I traveled to Chile with the Solar Wind Sherpas, an international group led by Dr. Shadia Habbal from the University of Hawaii Institute for Astronomy, to make observations of the solar corona and gather information about its elemental composition. Pre-eclipse solar data were compiled for 30 days prior to the eclipse to have an idea of how the shape of the corona may be affected by solar activity. Minimal solar activity was observed leading up to the eclipse. During the eclipse, I was assigned to a team stationed at Mamalluca Observatory, where I focused my efforts on setting up and operating the narrow band imaging assembly. Narrow band images were taken for Fe XI, Fe XIV, and Ar X emissions of the Sun's corona to study its density and temperature.

Maryam Haytham Esmat
Space Telescope Science Institute and Lycoming College
Title: Simulating James Webb Space Telescope Observations of Transiting Exoplanets
Session #: 1
Poster #: 122

The James Webb Space Telescope (JWST) will operate primarily in the infrared band when it launches on March 2021. The Near-Infrared Camera (NIRCam) is one of the infrared instruments on the JWST. My research utilizes MIRaGe, a Python package written and developed at Space Telescope Science Institute to create Time Series Observations (TSO) data for JWST's various infrared instruments. NIRCam TSO modes, Imaging and Grism, focus on high accuracy photometric monitoring and spectrophotometric monitoring. Long-duration observations examine the brightness of a source to search for variations over time; in the case of exoplanet transits, the source would be the exoplanet system. MIRaGe's capability to create TSO data allows the JWST mission to monitor exoplanet transits through software analysis and tests the calibration pipeline. I wrote a Jupyter notebook that allows the exoplanet community to enter parameters for the exoplanet system of interest to evaluate these parameters and make sure they return the appropriate results for the NIRCam instrument; I will be giving a workshop at the AAS Meeting in January on how to use this notebook.

Cade Hensley
Missouri Southern State University
Title: Sharing the significance of physics in everyday life through community outreach – Engaging pre-K to general public
Session #: 1
Poster #: 62

Missouri Southern State University's chapter of the Society of Physics Students has had a strong presence in the local community this past year via outreach activities to help create interest in physics in all ages and promote learning within the community. Our SPS chapter aims to provide an inclusive and supportive environment via hands-on activities, and embracing discovery-based learning in which everyone feels welcomed in physics. Throughout the academic year we perform fun science experiments for pre-K kids, present science shows at local primary schools, conduct physics activity booths for elementary school students, carry out engaging physics demo sessions for middle schools, lead hands-on activity sessions highlighting conceptual understanding and enhancing computational skills for high school students, and make the local community on and off campus get excited about physics. Here we present the summary of our activities from the previous year, and the framework of events planned for this academic year while focusing on methods to connect the chapter of SPS with the university and local community.

Olga Hernandez
University of Texas Rio Grande Valley-East
Title: Seeking Asteroids: Survey of the Ecliptic Plane
Session #: 2
Poster #: 98

Asteroid impacts are not a new phenomena. Though they are a natural disaster, they might also be preventable. Detecting near-Earth asteroids is the first step in removing Earth from the collision course. In this work, the processes and data I've acquired during observation nights searching for such asteroids is presented.

Aurelien Hong
Siena College
Title: Restoring an Apparatus for Measuring the Earth's Gravitational Potential
Session #: 2
Poster #: 92

Most recent observations of the mass distributions around large gravitational objects (stars, galaxies, galaxy clusters) point towards the so-called "dark-matter" hypothesis. A variety of theories have been presented so far to address this "missing mass" problem. Part of the scientific community thinks that dark matter is made of "new" particles, still to be discovered. An other part is convinced that the laws of gravity need modifications (e.g. Modified Newtonian Dynamics, or Emergent gravity). We address this problem by restoring and improving an apparatus to measure deviations of the gravitational potential around the Earth due to the interaction with the Moon and Sun (tidal forces). The apparatus measures the weight of an object on an analytical balance over time, and record weight changes over time. We illustrate the process of setting up the analytical balance with all the related components, including a new data acquisition protocol, and several technical upgrades.

Sabid Hossain
Davidson College
Title: Large Momentum Behavior for SUSY ISW models 1/p^(s+2)
Session #: 1
Poster #: 77

The Infinite Square Well is one of the few problems in quantum mechanics with exact solutions. By applying Lie Superalgebra to the Infinite Square Well, we can create Supersymmetric Square Well, or a SUSY ISW. Each version of the SUSY ISW has a shifted ground state; this allows for a more realistic potential function as the well is further shifted. We can then use the SUSY ISW to model realistic situations. By applying Fourier Analysis to the Schrodinger Equation, we can obtain the momentum space equation for the SUSY ISW. The equation is an integral that is difficult to solve analytically and takes a long time to solve computationally, especially for higher supersymmetric families. We were able to simplify the equation into a master momentumspace equation, that allows the computer to solve problems much faster. From there, we deduced that high momentum behavior is independent of n, or the energetic state, of the system. The large momentum behavior follows the trait of the Infinite Square Well (which modeled 1 /p^2) by only being dependent on the supersymmetric family. This behavior is modeled as 1/p^(s+2)

Christopher Howard
Society of Physics Students
Title: Electric Field Effect on the Magnetic Resonance Line Width of Charge Carriers in a Conjugated Polymer
Session #: 2
Poster #: 72

When a ?-conjugated polymer is used as the active layer of an organic light emitting diode (OLED), the application of an external electric field will induce a change in the charge-carrier recombination of electrons and holes via short-lived excitons. We monitor the fluorescence through optically detected magnetic resonance (ODMR) spectroscopy, where spin transitions between singlet and triplet states occur at magnetic resonance [1]. We conducted ODMR spectroscopy on organic thin-film capacitors to study the effects of external electric fields on the spectral line width of due to spin-dependent recombination processes. We fabricated capacitors with thin films of the polymer Poly[2-methoxy-5-(2'-ethylhexyloxy)-p-phenylene vinylene] (MEH-PPV) as the dielectric. We applied an external electric field in the range of 0V to 150V across the capacitor electrodes. The devices are then photo-excited with 30mW of light from a 405 nm laser, and the change in the photoluminescence is detected under magnetic resonance condition at an excitation frequency of 128 MHz. We recorded ODMR spectra for various applied electric fields in order to investigate the change in line widths with electric field.

Sinead Humphrey
DePaul University
Title: Gravitational Wave Signals from Core Collapse Supernovae
Session #: 1
Poster #: 5

The detection of gravitational waves (GWs) from core collapse supernovae (CCSNe) could provide insight into their astrophysical properties. Due to their relativity small GW emission, any improvement in recovering energy from a generic supernova signal could be critical to discovering GW's from one occurring in our galaxy. We evaluated possible techniques for recovering more information from CCSNe GW signals using X-Pipeline. X-Pipeline uses data from multiple interferometers; clusters of “loud” pixels, and statistical properties to differentiate GWBs from other sources of loud noise transients. The pixels on the final time-frequency map are grouped using the “nearest neighbor” method. With this method, the loudest pixels are grouped with other loud pixels adjacent to them to form an event. This may not be the best clustering model for finding GW signals from CCSNe. We first varied the connectivity of the clustering method; increased connectivity means greater distance between “neighboring” pixels. We injected 3 GW signals from simulated CCSNe into realistic aLIGO noise and calculated the energy recovered at different grid sizes. We found that the 3 CCSN signals show similar increases in energy recovered. Therefore similar signals may be more likely to be detected when using larger connectivity.

Shahid Hussain
Cal State Sacramento
Title: Developing and Testing a Safety System for the ATLAS Experiment's ITK Inner Pixel Prototype at SLAC
Session #: 2
Poster #: 71

The Large Hadron Collider is currently undergoing upgrades that will increase the energy level of the beam, improve the trackers within the ATLAS and CMS detector, as well as improve the magnets used to guide the beam, it will be upgraded to the new and improved: High-Luminosity LHC. Part of the upgrade involves the ITk of the ATLAS detector, specifically the Pixel Detector. At SLAC, they are working on prototyping the new Pixel Detector and running various tests on the modules that will be installed in the new detector. My project revolved primarily around the safety of the modules that will be tested. I was to create an interlock system for Prototype-0 that would measure the temperature and humidity of a controlled environment and cut off power to any module if there was an interlock situation.

Nour Ibrahim
Embry-Riddle Aeronautical University
Title: Spreading Science to the Next Generation Through an Assortment of Science Demonstrations
Session #: 1
Poster #: 131

Outreach is an engaging way of teaching science in which the boundaries of a classroom and a curriculum are broken down and, in their place, grows interactive and fun learning. SPS provides undergraduate physics students with a variety of resources to either kickstart their outreach journey using the Science Outreach Catalyst Kit (SOCK) or simply provide veteran students with some ideas for the next outreach event through the demonstrations on the SPS website. This year’s SOCK uses food to teach about physics in space. The SOCK includes two demos, one that simulates gravitational waves in jello, and the other shows impact craters in a brownie. Besides the SOCK, some general demonstrations were created and uploaded on the SPS website and they range in topic, difficulty, and the target audience. All of these resources are free for any student or any chapter to access and use.

Jasmine Jackson
Towson University
Title: Superhero Physics as a Teaching Tool in Introductory Physics
Session #: 2
Poster #: 135

The superhero universe is governed by laws that differ radically from those in real life, but also mirror some of our preconceptions of how the world "should" work. We suspect that Flash cannot skip from cloud to cloud like a stone on the water---but why, exactly? Can we attach some numbers to that knowledge? We have combed through the comic literature for promising examples of superhero physics, focusing on concepts of force in Superman, uses and abuses of velocity by The Flash, and applications of energy in Captain Marvel. Integrating semi-fictional "case studies" like this into introductory physics education can not only heighten student interest, but also deepen student understanding.

Giavanna Jadick
Duke University
Title: The Demographics of Science Policy Briefings on Capitol Hill
Session #: 2
Poster #: 47

In the House of Representatives, the Committee on Science, Space, and Technology regularly invites scientists and agency officials to share their work with Members of Congress. Policy briefings for staffers are held daily, hosted by organizations from local think tanks to universities across the country. The demography of these briefings provides a window into the fields they represent. This study was undertaken to better understand gender representation in the sciences. Data was collected on nineteen policy briefings. Between all events, 64% of panelists were male and 77% of audience question-askers were male. The gender of event facilitators did not significantly affect the gender ratio of the Q&A session (p=0.5598). However, there was a significant positive correlation between the gender ratio of an event's panelists and that of its audience question-askers (p=0.0327). Additionally, significant relationships were found between event topics and gender ratios: the percentage of STEM words in an event description negatively correlated with female question-askers (p=0.0384), and the number of diversity words positively correlated with female panelists (p=0.0360). Overall, there is a noteworthy relationship between women speakers and women audience members who engage during Q&A. This connection is further complicated by event topic, since the correlation is worsened during STEM events. This snapshot of the demography of Capitol Hill briefings demonstrates the value of representative event panels and should compel future improvement, especially at STEM events, for the sake of equitable engagement in the sciences.

Rutendo Jakachira
Drew University
Title: Fabrication of Femtosecond Laser-Induced Crystals in Lithium NioboSilicate 30: The effects of polarization angle on orientation and growth rate
Session #: 1
Poster #: 130

Laser-induced crystallization is an effective way of fabricating crystals in glass materials owing to the fact that the process is clean, precise and non-contact require contact. The crystals obtained are of interest because of their potential use in optical data transmission. However, controlling the refractive index modification ie the formation of the crystals is an issue which is yet be concurred. One topic of interest is the relationship between the angle of polarization of the writing laser and the grain size and orientation of the crystals. Cao et al observed that at moderate pulse energies, (0.5-0.9?J/ pulse, 300kHz) textured nano crystals are obtained with their polar axis perpendicular to the writing laser polarization direction.

William Jeffreys
Howard Community College
Title: Fantastic Exoplanets and Where to Find Them
Session #: 2
Poster #: 51

An exoplanet is any planet outside of our solar system, and our research team wanted to demonstrate that Howard Community College (HCC) has the ability to detect them. By observing the drop in a host star's brightness as an exoplanet orbits around it and in front of our field of view, the exoplanet's size and inclination can be determined with some prior knowledge about its host star. A 14" telescope was assembled and used on HCC's campus to take a sequence of images before, during, and after the predicted transit. A known exoplanet was selected with a promising predicted transit to measure its properties and demonstrate the capability of the new equipment. Data is presented from a successfully observed transit on November 4th, 2018 of exoplanet WASP-50b around the host star WASP-50. During the 1.8-hour transit, a 1.6% (±0.1%) drop in brightness was observed in the host star. Inputting the change in brightness over time into an accepted model, we inferred the existence of an exoplanet with a diameter 15% (±1%) larger than Jupiter and an inclination of 86° (±2°), which is consistent with published values. The long-term goal of the project is to contribute to the field of astronomy through collaboration with the recently-launched Transiting Exoplanet Survey Satellite (TESS).

Maegan Jennings
Towson University
Title: A Model for Intergalactic Dust and its Impact on the Extragalactic Background Light
Session #: 1
Poster #: 48

The sky is dark at night, even though the universe is infinite and uniformly filled with light sources. Think about that for a second. Why don't we see galaxies in every direction, just as we see trees in every direction in the middle of a large forest? This question is known as Olbers' paradox in cosmology. Its resolution is known to be mostly due to the fact that the speed of light and the age of the universe are both finite (and, to a lesser extent, the fact that space is expanding). But do these factors explain the entire darkness of the night sky? There is also a dusty intergalactic medium (IGM) that is particularly good at absorbing visible light and re-radiating it at longer wavelengths. Observations of quasar reddening are now becoming sensitive enough to constrain the properties of the IGM, but its quantitative effect on the spectral intensity of the extragalactic background light (EBL) has yet to be established. We use Mathematica to calculate this intensity within standard relativistic cosmology, representing the light of galaxies with a combination of blackbody functions at different redshifts, and convolving it with a detailed model for intergalactic dust. A crucial feature is the use of ListInterpolate to calculate dust opacity as a function of redshift and wavelength, reducing a time-consuming double integral to a much faster single integral. Our results suggest that intergalactic dust may play a more significant role in darkening the night sky than has usually been thought.

Martha Jesuit
Coe College
Title: Analysis of Thermal and Structural Properties of Alkali Oxide Modified Tellurite Glasses
Session #: 1
Poster #: 65

Lithium, sodium, potassium, rubidium, cesium, and pure tellurite glasses were investigated to better understand their structure and how these glasses could be applied to the real-world. Tests such as differential scanning calorimetry, pycnometry, x-ray diffraction, Raman spectroscopy, and infrared spectroscopy were all performed on these glasses up to 25 mol%. Pure TeO2 glass was made using the water quenching method (Tagiara et al), and all other glasses were formed by cooking the mixture for 15 minutes at 1000oC in a platinum crucible, then simply letting the melt cool inside the crucible and glass was easily formed. The coordination number of these glasses was the main goal because of recently published papers, which had different outcomes of their coordination numbers for pure TeO2.

Shantanu Jha
Yale University
Title: Coupled Ring Quantum Cascade Lasers as Scalable Terahertz Transceivers
Session #: 2
Poster #: 12

In this study, we demonstrate a pair of coupled ring quantum cascade lasers as scalable generators and receivers of wireless communication signals in the terahertz gap, a high-frequency region of the light spectrum currently untapped for lack of practical sources and detectors. By leveraging the fast gain medium of mid-infrared quantum cascade lasers operating in the frequency comb regime, we show the tunable generation and potential detection of sub-terahertz signals. Through the optical coupling of QCLs with novel ring geometries, we scale up the power of these sub-terahertz beatnotes. Beatnotes, described as the optical analogs of the beat tone between sounds of near-identical pitch, reside at the difference frequencies of their constituent, interfered signals. First, we demonstrate the tunable and heterodyne generation of a sub-terahertz beatnote between two single mode frequencies, one from each coupled ring QCL. We then operate both ring QCLs in frequency comb states that we subsequently synchronize by optical mode-locking. While we are able to produce a stronger heterodyne beatnote from the beating of two single mode frequencies, we find that the beatnote produced from two synchronized frequency combs is much narrower. This research serves to characterize the novel dynamics of coupled ring QCLs while demonstrating their potential to provide powerful sub-terahertz signals necessary for the next generation of wireless communications.

Marcos Jusino
SPS UPRM Chapter
Title: The Occurrence of Planets in the Abiogenesis Zone
Session #: 2
Poster #: 131

Precursor molecules to the building blocks of life such as ribonucleotides, amino acids and lipids could have been produced in an early, prebiotic Earth in which ultraviolet radiation induced the activation energy required to trigger photochemical reactions. The Abiogenesis Zone, as defined by Rimmer et al. (2018), is the zone in which a yield of 50% for the photochemical products is obtained, adopting the current UV activity as representative of the UV activity during the stellar lifetime and assuming a young Earth atmosphere. When applying the Abiogenesis Zone to our catalog of Potentially Habitable Exoplanets we found eight candidates. Although all of these eight exoplanets are inside both the Habitability Zone and the Abiogenesis Zone, they are all warm superterrans (i.e. Super-Earths or Mini-Neptunes), and less likely to support life. So far, not a single Earth-sized planet has been discovered to be in both the Habitable Zone and the Abiogenesis Zone.

Vicki Kelsey
New Mexico Tech
Title: Atmospheric Precipitable Water and it's Correlation with Clear Sky Infrared Temperature Readings: Field Observations
Session #: 1
Poster #: 34

Precipitable water is the total amount of water vapor which is contained in a vertical column of air that stretches from the Earth's surface to the top of the atmosphere. It is expressed in terms of what the depth of liquid water would measure once all the water vapor in the column is compressed down into liquid form. Meteorologists currently use ground-based global positioning systems (GPS), microwave radiometers (MWRI), and radiosondes to measure precipitable water. Due to the cost and complexity of these instruments, the number of locations where these measurements are taken is limited; therefore most National Weather Service (NWS) monitoring sites do not measure precipitable water. Meteorologists need precipitable water measurements to help accurately forecast storm formation, strength, and the likelihood of precipitation. We utilize the methodology from a previous study in which relatively low-cost infrared thermometers were used to determine the precipitable water over the Gulf Coast of Texas. This approach is being tested in the climate zone found in Socorro, NM using daily ground and clear sky temperature measurements. This research demonstrates the ability to measure precipitable water with low-cost tools in higher altitude arid climate zones similar to that found in the desert Southwest.

Areeba Khalid
Adelphi University-Physics
Title: Analysis and Generation of Frequency Sidebands in a Lithium Niobate Phase Modulator
Session #: 1
Poster #: 93

In general, two or more laser frequencies are needed to collect atoms in a magneto-optical trap. In our experiment, the primary cycling transition for Rb atoms is generated by an external-cavity diode laser that is stabilized to an atomic reference cell. The second "repump" frequency is generated by modulating the phase of cycling laser in a Lithium Niobate Phase Modulator. The sidebands are tuned to the exact frequency difference between the transitions. We will discuss our study of how the sidebands are generated, their dependence on driving voltage, and a circuit for generating the 3 or 6.8 GHz RF signal required to drive these sidebands for "Repump" frequencies.

Shanjida Khan
Drew University
Title: Flow Analysis and UniverScope: Complementary techniques to monitor multicellular spheroid growth
Session #: 1
Poster #: 132

To monitor the growth of multicellular spheroids as model tissues, we used two complementary techniques. The first one relied on an image-free analysis of the light absorbed by the spheroids. Detection of the light passing through the spheroids allowed us to determine the extinction coefficient of the cellular material and the size of the spheroid. In order to validate this image-free size determination, the size of the spheroids was also measured by optical microscopy. The second one consisted of building a novel microscope (UniverScope) that allows parallelized, high throughput, imaging of spheroids in physiological conditions. To correctly setup the UniverScope, 3D printing was used to create aperture filters and mounts for microlens arrays, which would be used to image spheroids. As a result, these two methods were aimed at measuring the spheroid radius as a function of time and at gaining insight into the fate of cells within the spheroid.

David Kieke
University of Wisconsin - River Falls
Title: Evaluating the Spectral Power of a Light Source for Use on Aged Parchment
Session #: 2
Poster #: 43

Spectrometers are commonly used for material characterization and identification in the world of historical manuscripts. These spectrometers utilize a close proximity light source which, if too powerful, could damage aged parchment. We characterized one of these light sources based on its photometric and radiometric output to evaluate the safety of manuscripts under its illumination. Using the spectrometer, we were able to determine the power distribution of the source, showing that there are significant amounts of infrared and visible light that could contribute to heat and chemical damage. By making measurements with a lux meter, we were able to compare the output to common photometric standards used by museums. We found that the PANalytical Fiber Optic Illuminator produced 27 lux-hours of illumination if the exposures were limited to 10 seconds with the probe 1/4" away from the target. This is within the 50 lux-hours cap many conservators use, but severely limiting in effective measurement time. The heating due to the light source was also examined because of light's ability to cause destructive shrinkage and drying. The heating and cooling curves of test parchments were recorded yielding potentially damaging temperature changes of 10 degrees Celsius in short time periods.

Annalies Kleyheeg
Boston University Physics Dept
Title: Searching for Axion Dark Matter with Nuclear Magnetic Resonance Techniques and Increasing Sensitivity with Optical Nuclear Polarization
Session #: 1
Poster #: 142

The Cosmic Axion Spin Precession Experiment (CASPEr) dark matter search utilizes Nuclear Magnetic Resonance (NMR) techniques to detect interactions of theoretical cosmic axions with gluon spins within lead-based PMN-PT ferroelectric crystals. Axion-gluon coupling will induce spin precession similar to that of a nuclear spin in an alternating magnetic field. Our cryogenic NMR apparatus will greatly improve the bounds of axion coupling, which in turn will provide invaluable information about this dark matter candidate. In order to improve the sensitivity of our apparatus, we plan to utilize a technique called Optical Nuclear Polarization (ONP), which induces hyperfine interactions between optically polarized electron spins and nuclear spins, to hyperpolarize nuclear spins in our crystal beyond the thermal limit. Illuminating the sample with linearly polarized 405nm light delivered from a laser source through fiber optic cable excites 1015 electron spins/cm3, which is the first step in achieving hyperpolarization. It also shortens the relaxation time of nuclear spins in the crystal, which improves measurement duty cycle. We are currently studying the effects of applying circularly polarized light to the sample, as this may help induce hyperfine interactions and polarization transfer between electron and nuclear spins. These results will play a major role in improving the sensitivity of CASPEr and increase our chances of detecting dark matter.

Shawn Knabel
University of Louisville
Title: Galaxy And Mass Assembly: A Comparison between Galaxy-Galaxy Lens Searches in KiDS/GAMA
Session #: 2
Poster #: 55

Strong gravitational lenses are a rare and instructive type of astronomical object. Identification has long relied on serendipity, but different strategies- such as mixed spectroscopy of multiple galaxies along the line of sight, machine learning algorithms, and citizen science- have been employed to identify these objects as new imaging surveys become available. We report on the comparison between spectroscopic, machine learning, and citizen science identification of galaxy-galaxy lens candidates from independently constructed lens catalogs in the common survey area of the equatorial fields of the Galaxy and Mass Assembly (GAMA) survey. In these, we have the opportunity to compare high-completeness spectroscopic identifications against high-fidelity imaging from the Kilo Degree Survey (KiDS) used for both machine learning and citizen science lens searches. We find that the three methods - spectroscopy, machine learning, and citizen science - identify 85, 69 and 76 candidates respectively in the 180 square degrees surveyed. These identifications barely overlap, with only two identified by both citizen science and machine learning. We have traced this discrepancy to inherent differences in the selection functions of each of the three methods, either within their parent samples or inherent to the method. These differences manifest as separate samples in lens mass and redshift. The combined sample implies a sky-density of ? 1/sq degree and can serve as a training set spanning a wider mass-redshift space. For future searches a combined approach would result in a more complete sample of galaxy-galaxy lenses.

Rudin Kraja
SPS- University of Texas at San Antonio
Title: Computational Modeling of the Electron Energy-Loss Spectroscopy (EELS) of Plasmonic Metasurfaces
Session #: 2
Poster #: 96

Electron energy-loss spectroscopy provides a unique approach when probing plasmonic nanostructures since it can locally excite and probe specific localized surface plasmon (LSP) modes. Contrary to optical spectroscopy, EELS is also able to excite and probe optically-dark modes such as the bulk plasmon and high order LSPs. An additional strength of EELS over optical spectroscopy is its ability to single out and investigate specific individual modes due to its local-excitation nature. Yet, to the best of our knowledge, only one theoretical paper (Garcia de Abajo, Phys. Rev. Lett. 2003) has explored the possibility of using EELS to study periodic nanostructures. Here, we investigate the plasmonic properties of 2-dimensional finite nanosphere arrays using the boundary element method (BEM) to solve the integral form of Maxwell's equations in the context of EELS. We performed a systematic study of key physical parameters such as the dimensions of the array, nanoparticle size, lattice parameter, metal composition of the nanoparticles. These EELS calculations will later be compared to optical calculations and photonic band structures calculations performed with the finite-difference time-domain method (FDTD). By exploring these parameters, we hope to gain a deeper understanding of the plasmonic properties of these metasurfaces.

Patrick Kralik
Coe College
Title: A glass neutron detector with machine learning capabilities
Session #: 1
Poster #: 66

The detection of neutrons above background levels is an indication of nuclear materials, creating significant applications for handheld neutron detectors in homeland security. For such applications, a 10B and 6Li enriched, scintillating glass neutron detector was designed. The model is compact enough to be used as a handheld detector and is equipped with machine learning capabilities to determine the location of the source and discriminate a neutron from a gamma. Lithium Borosilicate glass samples, with up to 70% 10B and 6Li content, and doped with Tb and Eu, were engineered to optimize the performance of the detector. The scintillation properties and neutron/gamma detection capabilities of the glass samples were tested. The model detector's performance was simulated in Geant4 and the simulation data was utilized for machine learning to predict the location of the source with an Artificial Neural Network (ANN). The reported handheld neutron detector design with the implemented artificial intelligence capability can achieve 99.9% accuracy in neutron/gamma discrimination, 8.9% error in radial angle estimates, and 2.9% error in azimuthal angle estimates.

Braden Kronheim
Davidson College
Title: Using Bayesian Neural Networks to Make Predictions from Supersymmetry Theories
Session #: 1
Poster #: 84

One of the goals in current particle physics research is to obtain evidence for theories beyond the Standard Model (BSM). Many of these theories are high dimensional, which makes searching through their possible predictions difficult. For this project, machine learning was used to make predictions from a simplified supersymmetric model, namely the phenomenological Minimal Supersymmetric Standard Model (pMSSM), a BSM theory with 19 free parameters. Specifically, a Tensorflow implementation of Bayesian Neural Networks was developed for this project to leverage modern day Graphics Processing Units in both the training and prediction phase and obtain confidence intervals. This algorithm was then used to learn to predict cross sections for arbitrary pMSSM parameter combinations, the mass of the Higgs boson they create, and the theoretical validity of the points. All three targets were predicted to a high degree of accuracy with 4.27 percent error or less and can now be used to make predictions significantly faster than traditional methods, with the cross section prediction occurring over 10 million times faster than previous algorithms. These results demonstrate the potential for machine learning to help probe these high dimensional spaces in BSM theories.

Veronica Kunzle
Howard Community College
Title: Exoplanet Photometry and detecting false positives
Session #: 2
Poster #: 60

The goal of our research is to assist in the detection of exoplanets, which are planets outside our solar system. This is accomplished through participation in the Transiting Exoplanet Survey Satellite (TESS) Follow-up Observation Program. The satellite detects a temporary drop in brightness in a star which then requires further observations with ground-based telescopes. One of our primary objectives with the TESS collaboration is to identify false positives, primarily due to eclipsing binary stars where two stars are orbiting one another in close proximity. Over a single night, a few hundred images are taken using a 0.36m telescope at Howard Community College. The time series of images can corroborate any dip in the brightness of the target star or seek alternative sources for the

initial signal. We will present examples of false positives detected with our telescope, and how to differentiate between a transiting exoplanet and an eclipsing binary star system.

Gregory Kuri
Towson University
Title: Gravitational Lensing and a First Test of Exotic Topology
Session #: 1
Poster #: 46

Dark matter and energy are widely accepted features of the current cosmological standard model, but they suffer from troubling questions of theoretical interpretation and a lack of direct experimental support. The standard model is based on Einstein's general relativity, which assumes that spacetime is topologically Euclidean. It may instead be smooth but topologically "exotic" (homeomorphic but not diffeomorphic to Euclidean spacetime). Since gravity = spacetime curvature, such a change could mimic the presence of dark matter or energy (the "Brans conjecture"). Remarkably, exotic versions of Euclidean space exist only for the case of four dimensions, where there are uncountably many of them. We use a metric that has recently been derived for one such smooth exotic spacetime by Duston and revisit the classical light deflection test of general relativity to obtain a first empirical constraint on the validity of Brans' conjecture.

Leif Kvarnes
Randolph College
Title: Tribology of Antimicrobial Surfaces
Session #: 1
Poster #: 140

Antimicrobial surfaces are being deployed in doctors' offices, airports, bathrooms, and other busy public spaces. We are working to create a means of measuring the effectiveness of these surfaces over time. The effectiveness of these surfaces over time is not well understood, and we are trying to develop a systematic method of creating lab-stressed samples.

Sally Lau
Adelphi University
Title: Adelphi Physics Innovation Center
Session #: 1
Poster #: 108

We will discuss our year long journey to construct an innovation center and maker space for Adelphi students in the physics department. We will discuss a few of the projects that have been attempted such as the construction of inexpensive EKG meters for classroom activities, support for teaching projects, and distortion petals for electric guitars. Ultimately, the center has not reached its expected outcomes; we will discuss our future plans for correcting this as well as lessons learned during the development.

Matthew Lazo
West Virginia University-Physics Department
Title: Observation of Space Weather with the Simulation-to-Flight 1 CubeSat
Session #: 2
Poster #: 104

Our planet is surrounded by a region of ionized gases, or plasma, which are trapped by the Earth's magnetic field. This region, called the magnetosphere, contains many regions of plasma with unique local plasma densities, temperatures, and magnetic field strengths. The Simulation to Flight 1 CubeSat is West Virginia's first spacecraft, designed and built by NASA IV&V in Fairmont, West Virginia. The scientific instruments on-board the CubeSat includes a Langmuir probe which is being used to determine plasma densities and temperatures in low-Earth orbit (LEO). The probe consists of a thin metal tip which is extended out into space and given a bias voltage. The voltage is swept from a negative to a positive voltage, collecting corresponding currents of positive ions and electrons. The current data collected can then be used to build a Langmuir current-voltage characteristic, or IV-trace, from which the local density and temperature of the plasma can be calculated. The goal of STF-1 is to test new navigational software and technologies for CubeSats, as well as to conduct several experiments designed by West Virginia University students and faculty. The

plasma density and temperature measurements calculated around the Earth will be compared to existing data on the subject to analyze and predict the effect of space plasmas on instruments and spacecrafts operating in LEO.

Isaac Lehman
Grove City College
Title: Hypergraph Isomorphism with a Connection to Quantum States
Session #: 1
Poster #: 19

Hypergraphs are useful data structures in the fields of pure and applied mathematics. We consider the problem of hypergraph isomorphism. We examine a specific subclass of hypergraphs which we hope will have sufficient restrictions to decrease the runtime for isomorphism checks. We present a method for this subclass which checks for isomorphism and demonstrate an improvement for up to four edges. In addition, we introduce a connection to quantum states.

Emily Lehman
Saint Joseph's University
Title: Stability of Thin Films: An Analysis of Film Lifetimes at Extreme Humidities
Session #: 2
Poster #: 23

Every child at some time has been fascinated with soap bubbles and their ephemeral existence. One doesn't normally think of these whimsical objects as having anything to do with serious science, but soap films, are ubiquitous, and occur over a wide range of phenomena. Thin films, and thin soap films in particular, remain a largely understudied and underappreciated branch of fluid dynamics. Despite the simplicity of their appearance, films often display distinct and unique patterns in their internal motion. Interestingly enough, Dawn Ultra© is the physicists' gold standard for studying the physics of thin surfactant (soap) films. The lifetime of soapy thin films was studied as a concentration of Dawn Ultra© in water-based samples at constant temperature and relative humidity (RH). Prior to film lifetime measurements, the critical micelle concentration (CMC) of Dawn was measured. These measurements were done using the Du Nouy ring method. The surface tension of a Dawn Ultra©-water solution decreases until the CMC point is reached. The data from this study evinced a CMC of 27.27 mN/m corresponding to a concentration of 17.19 mg/L At effectively 100% RH, the thin film lifetime was observed to scale exponentially with surfactant (soap) concentration, ranging from approximately 85 s at 1% Dawn (by volume) to over 2000 s at 100%. Surprisingly, at ~60 RH, lifetimes spanned a range of 23 s at 2% to approximately 7400 s at 90%. Studies are continuing at intermediate RH.

Jayden Leonard
Marshall University
Title: Electronic Structure of Negative Trions in Quantum Dot Semiconductors
Session #: 1
Poster #: 17

A trion system is one that includes an exciton system pairing with either an electron (called a negative trion) or a hole (called a positive trion). Trion systems have been a topic of extensive theoretical and experimental study, especially those contained within bulk-semiconductors. Trions in this system typically contain very infinitesimal binding energies, but recent research has used the fact that a trion within a quantum well will have its binding energy increased by an order of magnitude, to produce measurements of the photoluminescence spectra of the trions in a single, self-assembled quantum dot. This data could now be used to show how dependent the photoluminescence lines are on the size and geometry of the quantum dot In this project, we will theoretically investigate the electronic structure of negative trions in a quantum dot of a direct band gap semiconductor. We also study the effect of an electric field on the trions. We obtain the splitting of trion energy levels under the electric field. The respective wave functions of the resulting states have been obtained as well.

Theresa Lincheck
Cleveland State University
Title: Uncovering the Relationship between Entrainment and Cloud Size
Session #: 1
Poster #: 30

Clouds are one of the most important contributors to the regulation of the weather and global climate, yet their complexities make them extremely difficult to accurately predict in climate models. One of these complexities is entrainment, or mixing, of environmental air into clouds which causes clouds to cool and evaporate over time. In this study, we investigate the dependency of entrainment on cloud size by evaluating data from several Large Eddy Simulations. Results from this study demonstrate that the amount of entrainment varies across simulations and cases and may depend on the order of averaging in calculating entrainment values, the precision of the simulation, or the type of simulation used itself. However, in general we only find a dependency of entrainment on cloud size for the smallest clouds, which is in contrast with common assumptions in climate models.

Cassandra Little
University Of Houston
Title: Extinction Monitoring with MPPCs in the PIP-II Accelerator
Session #: 2
Poster #: 77

As Fermilab prepares for new experiments built to probe new physics, enhancements to its accelerator complex need to be implemented. The PIP-II linear accelerator upgrade requires new, innovative ways to measure the extinction between the bunches of its beam. The PIP-II beam will be entirely composed of H-, omitting the process of stripping H- to H+, making previous extinction monitoring techniques inadequate. Bunches of particles are produced by using a laser to notch, to remove an electron from, a beam of H- ions. By using Multi-Pixel Photon Counters (MPPCs/SiPM) we can effectively monitor electrons emitted from notching the beam without affecting the H- stream. I observe the relationship between the noise rates and temperatures of a S13360 and a S13370 series Hamamatsu MPPC, as well as the apparatus' effectiveness in observing electrons emitted from a Strontium-90 source. It was found that the MPPCs have adequate resolution to observe electrons and differentiate them from noise at cool temperatures around 243K. The required minimum energy of electrons to be resolved at this temperature is expected to be less than what is needed in the PIP-II accelerator.

Troy Long
Angelo State University
Title: Piezo-Electric Optical Computing
Session #: 1
Poster #: 97

A computer is a machine that quantifies natural phenomena to simulate mathematical functions. There are two paradigms for computers: analog and digital. Digital computers that use relative extremes to simulate discreet mathematics. Analog computers implement continuous natural properties to replicate continuous functions. Analog optical computing has the potential to transfer information rapidly, using atomic emissions as an optical transistor. Optical equipment was used in order to demonstrate one way light can be used to produce calculations. A laser was used to reflect a beam of light off a mirror mounted to a piezo-electric crystal element, creating a simple optical transistor. When a voltage is applied across a piezo element, it mechanically expands. By placing the piezo element under the mirror like a shim and applying different voltages, the normal line between the mirror and the beam shifted, causing the beam to repeatably reflect to different locations on a screen. Using a photo-detector, numerical values can be taken from the intensity of the light shining on the detector. The presentation will include the design process for creating the piezo-electric optical demonstrator, for the purpose of encouraging creative, critical thinking in new fields of computer development.

Trevor Lowing
Towson University
Title: Steam Power as a Teaching Tool in Physics and Science Education
Session #: 2
Poster #: 132

We describe how we have overhauled and revitalized two courses at Towson University by implementing field trips based on steam power. The two courses are Physical Science 101 (an introductory course for science education majors) and Physics 352 (an upper-level course in thermodynamics and statistical mechanics for physics majors). With the help of small internal grants, we brought these classes to Baltimore's B&O Railroad Museum and the Wilmington & Western Steam Train in Delaware. The physics majors spent an entire day learning how to apply their theoretical training about Carnot cycles, efficiency, etc., to the practical problem of mass transportation. In the process they learned how physics once changed the world by ushering in the Industrial Revolution --- and challenged to imagine how it might change the world again today. Next year we plan to repeat this exercise with a trip to the S.S. John W. Brown, one of only two still operating steam piston-powered "Liberty Ships" from World War II.

Manuel Lozano-Arroyo
Universidad de Puerto Rico-Mayaguez
Title: A study of the elctrical properties of V3O5 deposited by magnetron sputtering
Session #: 2
Poster #: 125

Most vanadium oxides exhibit a Metal Insulator Transition (MIT) at some critical temperature, including variations in electrical and optical properties. V3O5 exhibits MIT at 430 K, the highest known temperature value among all vanadium oxides. This relatively high transition temperature makes V3O5 valuable, since this higher junction temperature will produce less unintended thermal switching. However, even a small deviation from exact stoichiometry can change the electrical properties of the thin films. In this work V3O5 thin films were deposited directly on glass substrates by DC magnetron sputtering, with subsequent thermal treatments. The layers were characterized by electrical resistivity and Raman spectroscopy as a function of temperature, X-ray diffraction (XRD), and atomic force microscopy (AFM).

Reyes Lucero
Coe College
Title: Using a Software Defined Radio to Collect and Measure VHF Pulses
Session #: 1
Poster #: 56

At Los Alamos National Laboratory, our team uses the Los Alamos Portable Pulser (LAPP) to test spaced-based Very High Frequency band (VHF) sensors. A Marx generator produces high-power pulses, which radiate through a canted, bow-tie feed antenna and reflect off a parabolic reflector into space. This setup is highly effective, but due to the complexity and dynamic nature of a Marx generator and this system, its electrical characteristics are hard to measure or model. Additionally, switching to a helical feed antenna may improve the LAPP's power output. We needed a method to measure this complex system and compare the performance of the bow-tie to a helical antenna. Software Defined Radios or SDRs offer a viable approach to analysis of radio signals. We used an Ettus X300 SDR with a UBX-160 daughterboard to measure the power transmitted from both antennas and compare their output. We connected the SDR to an A.H. Systems SAS-540 Bicone antenna and placed it in the far-field radiation region, choosing locations to minimize multipath reflections. This allowed us to measure the received power spectral density for both antennas. Acknowledgements: Lupe Romero and Shawn Hinzey loaned us test equipment. Aaron Minard provided valuable input to the poster. Victor Popa-Simil managed coaxial cable. Zach Baker provided code improvements. LA-UR-19-30986

Helena Lyng-Olsen
Yale University
Title: Not available
Session #: 2
Poster #: 20

Abstract not available.

Matthew Macasadia
Texas Lutheran University
Title: Development of a Mobile Integrating Sphere Platform for Measurement and Validation of Tissue Optical Properties
Session #: 1
Poster #: 80

The desire for a better understanding of the optical properties of heterogeneous tissue is continually growing. Optical properties are required for increased modeling of laser-tissue interaction. Two of these optical properties, the absorption coefficient and the reduced scattering coefficient, cannot be measured and must be back calculated from other measurable values, such as the reflectance and transmittance. One way to obtain these values requires the use of integrating spheres. We will discuss the development of a mobile integrating sphere platform to measure tissue sample and present validation for obtaining accurate tissue properties.

Gradmar Maldonado
University of Puerto Rico Mayaguez Campus
Title: Knowledge of High School Students from Puerto Rico in Physics and Astronomy
Session #: 2
Poster #: 128

As a whole, physical concepts can be experienced in our daily lives, which means physics revolves around us. It is important to know about these physical concepts, as they explain how the nature of things work. Students coursing through high school are sometimes required accreditation in a physics class, which means they should know basic concepts of how the world works. At least, they should acquire some knowledge of dynamics and kinematics from classical mechanics. In this research, it is proposed to see how well students retain their information of physics and astronomy having taken the course, or whether if students who have not taken a proper physics class understand or know about basic physical concepts. In order to measure this, students from different schools (both private and public) from different sectors in Puerto Rico were surveyed for a total of ten questions, all having to do with physical concepts. They were also asked basic demographic questions to see whether if there exists a correlation between a certain group of people and their understanding of the physical world. After tabulating and analyzing the data, 1% of all students surveyed knew absolutely nothing, 76% of all students had a "small" knowledge, 20% a moderate knowledge and 3% of all students had a vast knowledge in physics, based on our scale. It can be concluded that the knowledge of physics and astronomy students in Puerto Rico was overall deficient.

Jacob Malloy
United States Air Force Academy
Title: Photophysical Properties of Organogold(I) Complexes: Understanding How Ancillary Ligands Impact Excited-State Properties
Session #: 2
Poster #: 42

We report on the photophysical properties of a series of gold(I) complexes. These complexes consist of a benzothiazole-2,7-fluorenyl moiety joined to different ancillary ligands via gold-carbon ?-bonds. They absorb in the ultraviolet region of the electromagnetic spectrum and exhibit both fluorescence and phosphorescence. The ground-state absorption and luminescent properties of these compounds, as well, as excited-state lifetimes are compared for the different ancillary ligands in order to understand how modifications impact excited-state properties.

Matthew Mancini
New College of Florida
Title: Shape and Scale Independent Direct Surface Area Measurement Method from Digital Images
Session #: 1
Poster #: 126

A direct, shape, and scale independent digital image measurement method of the surface area (SA) of individual objects is proposed. The algorithms presented herein utilize the brightness histogram of 8-bit grey scale images, and thus are referred to as Brightness Histogram Surface Area Measurement Algorithm (BHSAMA). The proposed SA measurement technique allows the uncertainty of the single measurement reading to be evaluated by traditional error propagation. This fact alone presents a significant advantage to the current methods utilizing image segmentation and/or edge detection whose measurement uncertainties cannot be quantitatively analysed. The proposed method does not involve any shape-related approximations. Five examples illustrating the method are discussed. For method verification purposes, a series of digital simulations using a control sample of predetermined size is undertaken. The accuracy of the single measured SA reading is between 0.5 % and 1.5 %. The uncertainty of the measured SA is evaluated and discussed further as a function of two types of simulated blurred edge region. The two presented BHSAMA techniques can have wide range of applicability from nanoparticles, to cell biology, to aerial imagery.

Alicia Mand
Old Dominion University
Title: Rocket Propulsion
Session #: 1
Poster #: 113

This project explored spacecraft design through simulations and models, focusing on cost-effective propulsion. For earthbound spacecraft, chemical engines were the most cost-effective form of propulsion. However, for long term flight missions, it was found that ion propulsion and light sails were more cost-effective than their chemical counterparts. A rocket was designed with specific parameters in mind in order to simulate real-life circumstances. For example, the rocket's size and weight were restricted and carried a payload of two raw hen's eggs. The rocket was constructed out of balsa wood with 3D-printed fins and transition. The flight path and speed were simulated using OpenRocket and compared with flight data. The rocket's ascent and descent were speeds were measured by an altimeter and timer. A research review conducted to determine a more cost-effective and efficient propulsion system, found that chemical propellants, are the most cost-effective form of propulsion for exiting the earth's atmosphere. Electric propulsion systems, such as ion engines, are more effective for space travel. While ion engines are able to generate sufficient thrust in the vacuum of space, they are unable to attain escape velocity in the earth's dense atmosphere. For the rocket, it was found that the percent difference between simulation and real flight data for the altitude was 4.88% and for flight time, it was 4.35%.

Alexander Manduca
Saint Joseph's University
Title: Simon's Observatory Star Camera Instrumentation and Software Design
Session #: 2
Poster #: 3

The goal of this project is to fully automate a star camera that is capable of continuously capturing images of the sky, running them through an astrometric software that measures pixel flux in each image and uses quadrilateral blob-finding to determine right ascension, declination, field rotation, altitude, and azimuth, and broadcasting these values continuously over a UDP to help determine telescope attitude for BLAST-TNG and for the Simon's Observatory. Our camera is a 2.35 Megapixel IDS UI that provides high resolution images, our lens is a Canon EF 200mm f/2.8L II USM, which permits short integration times and is equipped with stepper motors for remote focus and aperture control, and our computer is an Advantech ARK 1123C that enables completely autonomous functionality, saves images, and allows for VGA display of real-time astrometric solutions. BLAST-TNG (the Balloon-borne Large-Aperture Submillimeter Telescope - The Next Generation) is a NASA high altitude balloon program that studies star formation in high-redshift galaxies as well as star formation in the Milky Way and the effect of polarized dust as a foreground for current and future Cosmic Microwave Background experiments. The Simons Observatory is being built atop the mountains of the Atacama Desert in Northern Chile and will study universe formation and development.

Brina Martinez
University of Texas Rio Grande Valley-East
Title: Classification of Acoustic Noise in LIGO Livingston
Session #: 2
Poster #: 81

Noise is one of the biggest problems LIGO faces in their search for Gravitational Waves. Sources such as thunderstorms, trains, and other acoustic noise of anthropogenic origin cause scattering to occur in the beam tubes of the detector, which leads to issues in detection. In this work, Feature Extraction techniques and machine learning were used to characterize and classify acoustic noise from thunderclaps that affect LIGO. With the characterization of audio that LIGO does not want to pick up, we will be able to improve the functionality of the detector.

Jordan McClung
High Point University
Title: Effect of Ankle Sprain History on Ankle Inversion Biomechanics in High School Football Players
Session #: 2
Poster #: 54

The rate of ankle sprains is greater in high school football competitions compared to other high school sports. Greater ankle inversion motion, velocity and moment have been reported to be related to increased ankle injury risk. The purpose of the study was to examine ankle biomechanics during football-related tasks in players with a history of ankle sprain. 93 high school American football players volunteered to participate in this study. Participants wore retroreflective markers on the body and cleats for motion capture. Each participant wore standardized cleats and completed a weighted sled push (75% of body weight) and a jump-stop unanticipated cut on embedded force platforms. Peak ankle inversion angle, angular velocity, and peak external moment were calculated. Participants were classified by self-reported history of ankle sprain and by playing position. A mixed-model ANOVA was used to determine the effects of ankle sprain history, position, and type of movement ($p<0.05$). A statistically significant interaction (injury, position) was found during the cutting task. Backs/receivers with a history of ankle sprain exhibited significantly greater ankle inversion moment compared to linemen with a history of injury (large effect size d=0.90). A main effect of playing position was found for peak inversion angular velocity indicating backs/receivers had larger velocity compared to linemen. Technique and footwear modifications should be considered in backs/receivers at high risk of recurrent ankle sprains.

Tyler McDonnell
University of Maryland
Title: Quantum for Kids: You Got This!
Session #: 2
Poster #: 79

Early exposure to modern physics topics helps provide students with a foundation to navigate complex concepts throughout their academic careers. In an effort to bring STEM topics to the broader community, outreach activities are frequently designed by higher institutions and implemented to incite thought and interest in concepts such as physics. The University of Maryland Society of Physics Students (SPS) Chapter received the Marsh W. White Award from SPS National office to design a program of hands-on activities focusing on quantum concepts for elementary school students.

Peyton McGuire
Coe College
Title: Discoveries from the Expansion of the Glass-Forming Range of Zinc Borate
Session #: 1
Poster #: 57

The published glass-forming range of zinc borates was fairly narrow, between 1 ? J ? 2.13 (50- to 68-mol% of zinc oxide modifier in borate glass), with J being the molar ratio of zinc oxide to borate. The glasses within this range were formed using slow-cool/melt quench techniques. Using these techniques, a low amount of modifier would result in phase separation whereas exceeding this range would result in a polycrystalline solid. In this report, we used faster glass formation techniques comprising of plate and roller quenching methods to expand this glass forming range. Through these processes, the range was extended to 0.25 ? J ? 5.67 (20- to 85-mol% of zinc oxide modifier). Raman spectroscopy, Tg (the glass transition temperature), density and molar volume measurements were made for all samples produced; with these, we found that there was a decreasing trend in Tg as modifier increased. An important discovery was made when analyzing the molar volumes. The trend of zinc borate molar volumes was found to be extremely similar to the trend of lithium borates, indicating a structural similarity between borate glasses modified by zinc and borate glasses modified by lithium. Also, similarities were found between Raman spectroscopy measurements of both glass systems. These discoveries open new possibilities into the research of zinc borate glass and its possible use as a substitute for lithium and other alkali or alkaline earth borates.

Lilian McIntosh
Abilene Christian University
Title: Manufacturing Scintillator Tiles for the STAR Forward Upgrade
Session #: 2
Poster #: 18

Over the last 20 years, Relativistic Heavy Ion Collider (RHIC) experiments at Brookhaven National Laboratory (BNL) have studied the strong interaction through collisions between subatomic particles and nuclei. The Solenoidal Tracker at RHIC (STAR) plays a leading role in providing information regarding the proton structure, properties of the constituents, and their interactions. The STAR Forward Upgrade will enhance its capabilities by creating new low- an- gle subsystems, including a forward hadronic calorimeter system (HCal). The HCal, as well as a new forward tracker and electromagnetic calorimeter, will enable new low-angle measurements at STAR, including forward jet, dijet, and hadron-in-jet production. Abilene Christian University's (ACU) contribution to the construction of the HCal entails cutting and polishing 6,300 plastic scintilla- tor tiles to the specifications of the upgrade. In recent years, ACU has invested in new facilities that allow this large-scale production to be completed on cam- pus for the first time. A manufacturing process tailored to these facilities was developed to obtain optimal production efficiency and meet the specifications required for the upgrade. The specific process will be presented, including the scintillator cutting and polishing techniques.

Stephen McKay
Wheaton College
Title: Emission and Current Density Distribution in an Extended Magnetic Arcade
Session #: 2
Poster #: 29

We report on analysis of emission and current density distribution in the Wheaton Impulsive Reconnection Experiment (WIRX). The arcade-shaped plasma is formed between two parallel electrodes and is constrained by an outer magnetic coil. The setup is geometrically similar to magnetic arcades in the solar corona. Using relative light emission as a proxy for current density, we construct a model for the magnetic field and compare with probe data. We find good agreement, indicating that the emission intensity is roughly proportional to current density. The fraction of the electrode length occupied by current and the vertical extent of the current-carrying region in the plasma is examined as a function of total plasma current and vacuum magnetic field strength. Higher plasma current and lower vacuum magnetic field leads to taller arcades and more diffuse current distributions, consistent with expectations from magnetic force balance.

Jodie McLennan
Wheaton College
Title: Propagating Current Filaments in a Magnetic Arcade
Session #: 2
Poster #: 35

Propagating disturbances are a subject of great interest in magnetic loops and arcades in the solar corona. In the Wheaton Impulsive Reconnection Experiment (WIRX), arcade-shaped plasmas are formed between two parallel electrodes, geometrically similar to two-ribbon flares and magnetic arcades in the solar corona. We report on observations of structures that propagate along the arcade in the experiment and consider possible explanations. These events have been captured in ICCD images as well as with a 1D, 20 channel custom photodiode camera. The events have a robust velocity distribution that is unaffected by plasma density, ion mass, plasma current, magnetic field strength, and direction of propagation. We rule out slow or fast magneto-acoustic waves as the underlying physics because of the observed insensitivity to mass and magnetic field strength. We also rule out magnetic forcing similar to a rail gun because the events sometimes move opposite to the expected direction. The 3D magnetic field is measured with probes. Magnetic fluctuations are observed as the event moves past the probe location leading us to describe the events as propagating current filaments.

Samuel McMaster
Grove City College
Title: Optical Structure-Property Relationships of the Six-Spotted Tiger Beetle (Cicindela sexguttata)
Session #: 1
Poster #: 74

The mechanisms that cause insects such as jewel beetles to have iridescent elytra have been well studied and documented. The six-spotted tiger beetle (Cicindela sexguttata), however, is missing from the current literature. This study aims to identify the structures responsible for its metallic iridescence and green color. Due to the difficulty in finding C. sexguttata at the time of year when this study started, as well as a lack of experience in this vein of research, we elected to first attempt to recreate the results of previous studies on structure-property relationships in jewel beetles.

Robert Melikyan
Ithaca College
Title: Bennu's Natural Delivery Mechanism: Estimating the Flux of Bennu Particle Meteors at Earth
Session #: 1
Poster #: 98

The OSIRIS-REx mission has detected particle ejection events resulting in the release of cm-sized particles from the surface of asteroid (101955) Bennu [1]. While many of these particles return to the surface of Bennu, some are able to escape Bennu's gravitational field. This suggests that there may be a meteoroid stream of Bennu particles following an orbit similar to that of Bennu. These particles may pass close enough to Earth’s orbit to produce Bennu meteors [2]. In line with this suggestion, the OSIRIS-REx mission has established a collaboration with the Cameras for Allsky Meteor Surveillance (CAMS) project [3]. The goal is to search the Southern Hemisphere sky for evidence of a Bennu meteor shower in September of 2019 and beyond, during Earth’s annual approach to the Orbit of Bennu. In support of this observational search, we estimate the expected flux over the entire Earth and for an observer on Earth (number of meteors per unit time): we are simulating particle ejection and orbit evolution during each annual Bennu orbit crossing. This work may have broader implications for determining potential meteor activity from a large number of other small NEOs, as there is no reason to suppose the ejection phenomenon is unique to Bennu.

Wendy Mendoza
University of Texas Rio Grande Valley
Title: Stellar Occultation of Asteroid Chariklo
Session #: 2
Poster #: 99

A stellar occultation occurs when the light from a star is blocked by an intervening body such as planets, moon, ring, or asteroid. I will be discussing my research about the night I observed Chariklo making an occultation passing through a star. Chariklo was one of the first asteroids who was discovered with rings. It is also a centaur asteroid about 250 km in diameter. We were able to detect our first occultation at the Center of Gravitational Wave Astronomy. Creating new experimental methods that allow us to see gather data through our pipeline and have a lightcurve of the occultation.

Carrington Metts
College of William and Mary
Title: Lead Radius Experiment (PREX II) at Jefferson Lab
Session #: 1
Poster #: 102

The goal of the PREx experiment is to determine the size of the neutron distribution in 208Pb. Because this isotope contains 82 protons and 126 neutrons (a large difference), it is expected that some of the neutrons will arrange themselves in a “skin” on the nucleus’s surface. Although measuring the size of this skin is difficult, the technique of parity-violating electron scattering can be applied. The weak force is much stronger for electron-neutron interactions than for electron-proton; therefore, the measurable effects of the weak force on a beam of electrons interacting with the nucleus will effectively all be caused by the neutrons. These effects can be observed in the difference between scattering of right-handed and left-handed electrons, a phenomenon known as parity-violating asymmetry. However, such asymmetries can also be caused by changes in the electron beam’s properties (such as energy, position, or angle) that arise when the beam is switched from right-handed to left-handed or vice versa. Therefore, a beam-modulation system has been developed to measure the effects of these changes. Ultimately, this experiment should yield results sufficient to calculate the size of the neutron skin of 208Pb. In the long term, knowledge of this result will provide new insight into the properties of neutron-neutron interactions, which has applications in the study of neutron stars and 3-neutron forces.

Matthew Mikota
DePaul University
Title: Two worlds: Identifying How Students Translate between the Real World Context and the “Physics world” Context
Session #: 1
Poster #: 9

Assessments are crucial to education in the development of curricula and instruction as well as for assessing our learning goals. Recently, a change occurred placing scientific practices to the same level of importance and emphasis as core ideas of physics. The Three-Dimensional Learning Assessment Protocol was released to evaluate if assessments satisfied these new goals. Our questions were developed based on this protocol and focused on the scientific practice of developing and using models based on concepts from the introductory physics sequence. Introductory physics students answered physics exam style questions while doing a think aloud interview. We analyzed the data with the intent of identifying how students translated real world problems into physics conditions. Using thematic analysis we identified students key processes for translating between the real world and the “physics world” contexts. For example, students translated whether a rollercoaster’s radius is safe into the condition of a normal force greater than or equal to zero. The information gained from this study will help us better understand how students make connections between the real world and the “physics world”, as well as areas of confusion in converting between the two contexts. This knowledge will also help us further assess the usage of scientific practices and therefore further improve our assessments.

Prabhakar Misra
Howard University
Title: Lessons Learned in Diversity and Inclusion from the REU Site in Physics at Howard University
Session #: 1
Poster #: 79

During the period 2014-19, for two 3-year cycles of the REU Site in Physics at Howard University, 38 physics majors have benefited from the program by participating in leading-edge research projects in the areas of experimental, computational and theoretical condensed matter physics, optics and laser spectroscopy. The REU program, with a special focus on the investigation of nanomaterials, has provided a 10-week summer research experience to a targeted and diverse undergraduate student population from institutions with limited physics research resources. The REU Cohorts of physics majors have been truly diverse; they have included 13 females, 13 African Americans, and 5 other minority students. The Howard Physics REU has introduced participants to exciting research tools and methods in contemporary physics research and as a result the students acquired skills in specific methodology, while developing concurrently a keen awareness of the applications of physics to a broad range of cutting-edge physics topics. The REU site has served as a catalyst for talented students who may be undecided about pursuing a career in physics, providing them with skills needed to explore a range of career options in academia, federal government laboratories and private industry. Financial support from the National Science Foundation (Award Numbers PHY-1358727 and PHY-1659224) is gratefully acknowledged.

Nada Mohamed
Siena College
Title: CERN Open Data Portal
Session #: 2
Poster #: 100

Since the completion of the LHC and the launch of the Open Data Portal, CERN has uploaded and continues to upload data to the open data portal. In fact there is more than one petabyte of data right at our fingertips, so why not use it! We are trying to develop a more efficient and explicit way of accessing this data with hope that others can use it and lead us to new discoveries! Anyone can access this data and definitely should but throughout our work over the summer we targeted aiding theorists.

Gabriel Mohideen
Drew University-Physics
Title: Seeing Between The Lines: Background Subtraction In Confocal Microscopy
Session #: 1
Poster #: 110

Confocal microscopy is a proven technique useful for clinical sub-dermal imaging, as the high degree of depth sectioning available to a confocal microscope eliminates the need to remove surface layers of skin in a biopsy. However, typical high-end confocal devices can be several cubic feet in volume, too bulky for the fine maneuvering and difficult camera angles which convenient routine use may demand. Conventional line-scanning confocal systems can easily be scaled down, but as a consequence will suffer from additional background signal reception and image blurring. Our research concerns the construction of an optical microscope and the application of a background-subtraction algorithm to eliminate excess background signal noise and improve image quality to the standards required for clinical use.

Aric Moilanen
Middle Tennessee State Univ
Title: Disordered Electron Systems: A Local Quantum Cluster Model
Session #: 2
Poster #: 106

One essential factor in the modeling of quantum electron systems is the presence of disorder. Disorder is a ubiquitous feature of all real materials that can have extremely profound effects on the structural and transport properties of said materials. Disorder can even cause phase transitions in materials, such as the metal-insulator transition brought about by disorder-driven Anderson localization. We use the quantum cluster typical medium theory (QC-TMT) to identify when these transitions occur. QC-TMT is an effective medium theory, which employs the typical density of states rather than the average density of states, to distinguish between metal and insulator. As an ad hoc approximation, TMT is extremely dependent on using a good ansatz. However, if attempting to model a complex system, such as an interacting multi-orbital system, the use of a full cluster momentum K-dependent non-local ansatz makes computation nearly impossible. We tested the validity of using a simplified local-only ansatz for calculating typical density of states, which would make the simulation of such systems viable. The local ansatz neglects all non-local inter-site (K-dependent) effects in typical density of states, and only consider local (on-site) density of electrons. In our testing, we have found that the local-only ansatz agrees with the full K-dependent ansatz at disorder values close to the transition. Furthermore, we have established for what criteria, including disorder ranges, this local-only remains valid.

Zafir Momin
Adelphi University
Title: Utilizing unmanned aerial systems (UASs) to characterize plant canopy thermal properties in an Arctic tundra ecosystem
Session #: 2
Poster #: 37

The inadequate representation of vegetation structure (e.g. height, biomass) and functional (e.g. photosynthesis, transpiration, canopy temperature) properties across space and time in the computation models used to simulate the Earth system are key drivers of uncertainty in model forecasts of terrestrial ecosystems. This is particularly relevant for the Arctic biome, which is characterized by extensive surface area but with sparse observational data availability, particularly high-resolution spatial information about vegetation canopies. This project addresses this issue by employing high throughput drone-based remote sensing to quantify vegetation composition and distribution (i.e. where specific species or groups of species tend to grow) by their optical, structural and thermal properties combined with local topography and environmental variation; these groups of species are known as PFTs or plant functional types. Our platform combines three off-the-shelf instruments, a high resolution digital camera, thermal camera, and a spectrometer to collect very high resolution remote sensing data. Using these datasets, we explore the canopy thermal responses of these PFTs against different environmental factors such as air temperature, wind speed, relative humidity, and solar radiation. The main goal of this work is to find direct relationships between these factors and canopy temperature and examine how changes in climate may alter vegetation responses and composition in the Arctic.

Christian Montero
Siena College
Title: Exploring Atmospheric Aerosols as A Possible Explanation for DAMA/LIBRA Signal
Session #: 2
Poster #: 102

DAMA/LIBRA is an ongoing dark matter detection experiment conducted in Gran Sasso, Italy. Over 20 years, scientists have collected data that corresponds with an annual modulation one would expect from the motion of the Earth and sun through a galactic halo of dark matter. The physics community hasn't fully accepted these findings as proof of dark matter, and there are calls for alternative explanations. Our hypothesis is that seasonal fluctuations in the amount of potassium-40, a naturally occurring radioactive isotope, in aerosols which then finds its way into the experiment, is the cause of the DAMA signal. To collect the aerosols, we used a cascade impactor, a standard tool in the atmospheric aerosol community, and we also built an aerosol collector out of PVC pipe and 3D printed parts for comparison. To analyze the elemental composition of our samples we have explored the use of an X-Ray Fluorescence machine. The current status of this work will be presented.

Darin Mumma
Grove City College
Title: Speckle Interferometry of Prospective Cepheid and RR Lyrae Binaries
Session #: 1
Poster #: 10

Famously, Classical Cepheids (CCs) and RR Lyrae stars (RRLs) serve as standard candles, allowing astronomers to estimate distances both within and between galaxies. Previous surveys of these stars have revealed the surprising result that, although approximately half of all stars are binary stars, only a handful of CCs and a single RRL have been confirmed as binary systems. Identifying binarity among these systems is crucial as unknown binary companions can significantly skew brightness measurements of CCs and RRLs, systematically lowering the accuracy of distance measurements. Although extensive data sets on CCs and RRLs have become available to the public, many prospective binary systems in these sets require large telescopes and excellent seeing conditions to be resolved using traditional optical techniques. In this project, we apply speckle interferometry, together with two-dimensional Fourier analysis, to compensate for atmospheric blurring, allowing us to identify and characterize companion stars among candidate CC and RRL binaries separated by 0.4-5.0 arcseconds.

Anna Murphree
Rhodes College
Title: Monitoring AGNs with H? Asymmetry: A Study of Mrk704
Session #: 1
Poster #: 40

As part of the Monitoring AGNs with H? Asymmetry (MAHA) Collaboration, we present results of a long-term reverberation mapping (RM) campaign of Mrk704. Our high-fidelity data set was obtained with the Wyoming Infrared Observatory 2.3m telescope. Mrk704, a Seyfert 1 galaxy, has previously been reverberation mapped with complex results. We report a new broad-line region (BLR) time lag measurement and its corresponding black hole mass estimate. These results agree with previous measurements by De Rosa et al. 2018 and Afanasiev et al. 2019. We also present velocity-resolved time lags, which suggest a possible binary system. A close binary system may explain the complex H? profile and RM results, but more modeling is necessary to confirm this result. This work is supported by the National Science Foundation under REU grant AST 1852289 and PAARE grant AST 1559559.

William Musk
University of Virginia-Physics
Title: Fabrication of a Cosmic Ray Veto System for the Mu2e Experiment
Session #: 2
Poster #: 64

FABRICATION OF A COSMIC RAY VETO SYSTEM FOR THE MU2E EXPERIMENT. The Mu2e experiment at Fermilab will search for the charged-lepton-flavor-violating process of coherent muon-to-electron conversion in the presence of a nucleus with a sensitivity four orders of magnitude beyond the current strongest limits. The goal of single-event sensitivity requires that all backgrounds must sum to significantly less than one event. One potential background is due to cosmic-ray muons producing an electron with signal characteristics within the Mu2e apparatus. The cosmic-ray-veto system of the Mu2e experiment is tasked with vetoing such cosmic-ray-induced backgrounds with high efficiency while inducing low dead time and while operating in the high-intensity environment of the Mu2e experiment. The UVA HEP group has been leading the effort to design and prototype the CRV, and has recently started the fabrication of this detector on site. Dept of Phys., University of Virginia.

Lwendo Raymond Mwansa
University of San Diego
Title: E?ects of Strong Photospheric Dissipation on the Spectra and Structure of Accretion Disks with Non-zero Inner Torque
Session #: 2
Poster #: 32

We present numerical calculations of spectra and structure of accretion disks models appropriate for near-Eddington luminosity black hole X-ray binaries (BHB). Our work incorporates non-zero torque at the ISCO as well as several dissipation pro?les based on ?rst-principles three-dimensional disk interior simulations. We found that including both stresses at the inner disk edge and signi?cant dissipation near the photosphere can produce steep power law-like spectra for models with moderate viewing angles spanning a range of black hole spins . Consistent with previous studies, we also conclude that disks with stresses at the inner edge remain viable models for high-frequency quasi-periodic oscillations (HFQPO), especially given that increasing dissipation near the photospheres actually resulted in QPO power spectra with higher quality factors compared to those found in recent work.

Samuel Mycroft
High Point University
Title: The Effects of Surface Patterning on the Growth of Bacteria
Session #: 2
Poster #: 53

The smooth surfaces of surgical implants provide an ideal breeding ground for bacteria, which can lead to infection. Newer techniques seek to minimize the potential for bacterial infection by preventing the initial attachment of bacteria onto a surface. This prevention can be accomplished through introducing nanometer or micrometer-sized features on a surface. Examples of naturally occurring micro- or nano-structured surfaces that can be used as inspiration are lotus leaves and cicada wings, both of which have conically shaped features. We are investigating the effects of micron-sized surface patterns on the growth of bacteria. We present our process for creating these patterned surfaces and discuss future work to measure bacterial growth on them and to modify patterns to include both nanometer and micrometer-sized features.

Anton Navazo
University of San Diego
Title: Sterile Neutrino Dark Matter Models from Varying Particle Schemes
Session #: 2
Poster #: 84

An anomalous 3.55 keV emission line detected in the X-ray spectra of galaxy clusters can possibly be explained by the decay of 7.1 keV dark matter particles, namely sterile neutrinos. However, previously considered mechanisms produce dark matter distributions that are inconsistent with observed large scale structure. By manipulating a variety of particle schemes involving sterile neutrinos, we produce a variety of dark matter models. In this poster, we present the resulting spectra of these models and discuss the dark matter production mechanisms and subsequent large scale structure formation.

Yves Ngenzi
Abilene Christian University
Title: The E1039 drift chamber Cosmic Ray Commissioning.
Session #: 1
Poster #: 114

SpinQuest/E1039 is a fixed-target Drell-Yan experiment using the Main Injector beam at Fermilab, in the NM4 hall. It follows up on the work of the Nusea/E866 and SeaQuest/E906 experiments at Fermilab that sought to measure the d/u ratio on the nucleon as a function of Bjorken-x. By using transversely polarized targets of NH3 and ND3,SpinQuest seeks to measure the Sivers asymmetry of the u bar and bar quarks in the nucleon; a novel measurement aimed at discovering if the light sea quarks contribute to the intrinsic spin of the nucleon via orbital angular momentum. The E1039 Drift Chamber Cosmic Ray Commissioning will be discussed.Cosmic ray datasets were used to understand noise issues and to set nominal HV settings and thresholds for later beam runs. In addition to that, to reduce readout noise we studied the effect of adding ferrite cores to different readout cables

Christian Nieves Rosado
University of Puerto Rico, Mayagüez Campus
Title: Mechanical Properties of V3O5 Thin Films
Session #: 1
Poster #: 24

V3O5 is an interesting material which exhibits an insulator-to-metal transition near to 430 K. Its relatively high temperature transition makes it valuable in complementary metal-oxide-semiconductor (CMOS) devices. The amount of information documenting its mechanical properties is quite limited. Young's modulus of sputtered deposited V3O5 thin films has been determined for the first time by measuring the fundamental resonant frequency of silicon microcantilevers coated with V3O5. The films were then characterized by four-point probe electrical resistivity measurements, Raman Spectroscopy, X-ray diffraction, atomic force microscopy and laser deflection techniques, which were used to measure the cantilevers' resonant frequencies. The value of Young's modulus was found to be approximately 160 GPa.

Nwankwo-Ikechi Nwankwo
Texas Lutheran University
Title: Family Physics Night – an Extraordinary Outreach Event at Texas Lutheran University
Session #: 1
Poster #: 81

Texas Lutheran University Family Physics Night at is an annual outreach event that attracts nearly 400 people to our small semi-rural campus for an evening focused on the fun of physics. The event is a collaboration between the TLU SPS chapter and nearly every student registered in a physics class, including non-science majors. Participants are treated to a world-class public lecture, followed by a full evening of demonstrations and hands-on activities. Unlike some similar outreach events, TLU Family Physics Night is well attended by middle and high school students, making it an excellent opportunity to attract students to study physics. Participants represent diverse groups in age and interest, gathering together to wonder and be curious about things, some simple, and some more complicated! Our high school attendees are encouraged by regional high school physics teachers who send their students to the event for the enrichment and hands-on learning outside of the classroom. All activity stations are conceived and built by the faculty and students in the departments, with some projects assigned as part of the lab for certain courses. The activity stations are presented by students, who are required to practice presentations with faculty before being set loose on the public. This event has become an integral part of the culture and a valued recruitment tool for the TLU Physics department.

cynthia Olvera Perez
California State University-Chico
Title: Void Galaxy Properties Classified by Void Identification Algorithms
Session #: 2
Poster #: 45

The distant universe can be seen as a network of galaxies, a cosmic web, with clusters of galaxies connected together by thinner galaxy filaments, surrounding large, underdense voids. We analyze SDSS DR7 where we study properties of galaxies located in voids. Voids affect galaxy formation because their underdense environments cause galaxies to begin forming stars later in their life than galaxies in denser environments. There are two leading void identification algorithms: VoidFinder and ZOBOV. VoidFinder filters out faint and isolated galaxies and grows spheres in the empty regions. Voids are then defined as the union of these spheres. The filtered galaxies are reintroduced to the classified environments; galaxies located in a void are now considered void galaxies. ZOBOV is a watershed algorithm which filters out faint galaxies and calculates Voronoi cells for each remaining galaxy. The void galaxies are then defined as those with a cell volume greater than some threshold. We are interested in comparing how the two identification algorithms classify a void and how it changes the characteristics of a void galaxy. We compare the distributions of galaxy color, absolute magnitude, star formation rate, specific star formation rate, and inverse concentration index for those galaxies in voids defined by VoidFinder and in voids defined by ZOBOV. We find that VoidFinder void galaxies are bluer, fainter, have higher star formation rates and have higher inverse concentration indices than galaxies in denser regions. Conversely, void galaxies classified by ZOBOV are no different than galaxies in denser regions.

Roel Olvera,II
Texas Lutheran University
Title: Median Energy Imaging of Supernova Remnants In The Magellanic Clouds
Session #: 1
Poster #: 121

Supernova remnants (SNRs) play an important role in the chemical evolution of the Universe. The supernova explosion drives a shockwave that heats circumstellar material to X-ray emitting temperatures. The high-spatial resolution of the Chandra X-ray Observatory is particularly well-suited for studying the shocked material in SNRs. While Chandra imaging normally depicts the number of photons detected, we present an alternative representation that maps the energy distribution across the SNR. We achieve this by analyzing the list of photons in each pixel and determining the median value of the photon energies. The median energy value is used as the pixel value instead of the number of photons. We applied this technique to 44 remnants in the Magellanic Clouds. The resulting median energy images reveal a variety of features. We present these images and categorize their prevailing characteristics. This project was supported in part by the NSF REU grant AST-1757321 and by the Nantucket Maria Mitchell Association.

Jeremiah O'Mahony
Freelance
Title: What Everyone Wants You to Print
Session #: 2
Poster #: 93

The adage goes, “Journalism is what somebody doesn’t want you to print. The rest is advertising.” In that machismo-laced philosophy, reporting should exclusively be a tool of sticking it to the man, and articles that do anything less than scream truth to power are a waste of column inches. That puts journalists who report on science in an awkward position: there isn’t some shadowy figure with a vested interest in Quanta or Wired not publishing the latest in quantum computing. Science reporting, at its best, makes the most important advances in science understandable to the curious observer, no matter how complicated. There’s little in there to satisfy the combative nature of the old adage. Should science reporting be considered free advertising for scientists? During my time as the SPS intern with Physics Today, I struggled with preconceptions of what journalism “should be,” and in doing so tried to cram science reporting into a simplified framework of reporting. My poster, based on a presentation I gave at the conclusion of the SPS internship, represents the problems this conceptual mismatch posed and the conclusions I reached, moving past a combative view of journalism into a positive idea of truth-telling to benefit communities.

Jason Pagan
University of Massachusetts Boston
Title: Improved Receive Coil Sensitivity for Single-Sided Magnetic Particle Imaging
Session #: 2
Poster #: 110

On the forefront of biomedical imaging technologies is Magnetic Particle Imagining (MPI), a modality designed to image the distribution of superparamagnetic nanoparticles (SPIOs) with high sensitivity. Accumulation of SPIOs in tumor tissue, serving as tumor markers, would allow an MPI device to be utilized for in vivo clinical cancer imaging. Our single-sided design enables imaging of regions of interest in larger subjects, free of hardware constraints. Application of field-free line (FFL) geometry, of the magnetic selection field zero, has the advantage of higher sensitivity over the traditional field-free point (FFP) systems. Our prototype device uses a single primary coil to generate a magnetic excitation field. The SPIOs response to the excitation is detected by a surface receive coil. Optimizing receiver geometry can greatly improve the sensitivity, which in turn improves image quality upon reconstruction. The sensitivity of the SPIOs detection is directly impacted by the receive coil and is assessed by Signal-to-Noise Ratio (SNR). The receive coil geometry was optimized for improved receive field uniformity and maximum magnetic field strength. Increasing the inner diameter of the coil was simulated to improve receive field uniformity above the coil's center, while increasing outer diameter and winding number were calculated to increase overall field strength. Implementation of the improved coil's design resulted in a threefold SNR boost over the previous design, as experimentally demonstrated using SPIOs, thus validating the numerical simulations. Future studies of a novel gradiometer coil arrangement may allow further decreasing of noise, thereby increasing overall sensitivity of our MPI device.

Acacia Patterson
Oregon State University
Title: Variable Temperature Conductivity Measurements of Amorphous and Crystalline Polymorphs of Titanium Dioxide
Session #: 2
Poster #: 83

Acacia Patterson, Kelda Diffendaffer, Okan Agirseven, Patrick Berry, and Janet Tate Department of Physics, Oregon State University, Corvallis, OR 39331 Titanium dioxide is a well-known material, but the polymorph brookite has not been thoroughly investigated. We used conductivity measurements to determine electrical properties of amorphous precursor films of TiO_2 and the annealed crystalline versions (pure brookite, rutile, or anatase as well as mixed phase). We conducted variable temperature measurements of conductivity to obtain activation energies of these films, and we found a correlation between an increase in activation energy and decreasing conductivity. We also observed both increased and decreased conductivity after crystallization of the amorphous precursor films. We hypothesize that oxygen vacancies are the primary conduction mechanism and that that conductivity decreased when annealing filled the oxygen vacancies. Conductivity increased when the annealing did not fill as many vacancies, which was observed for anatase, which may oxidize completely even as a precursor. In this case, annealing improves crystallinity which increases mobility and hence conductivity. This finding is supported by optical absorption data from the films. This work is part of the Center for Next-Generation Materials by Design: Incorporating Metastability, an EFRC supported by the Department of Energy.

Victor Perez
University of Texas Rio Grande Valley
Title: Introduction To Magnetic Imaging: Imaging Skyrmions
Session #: 2
Poster #: 97

Magnetic Imaging is a very powerful tool that scientists from multiple disciplines utilize. Material scientists in physics use Transmissions Electron Microscopes to understand the properties of their samples at the nano-scale. Lorentz Force Microscopy is a type of magnetic imagine that uses a magnetic and electric field to determine properties of certain materials. Skyrmions are quasi-particles that have very interesting potential applications in computer technology. Using Lorentz Force Microscopy, we are able to determine the existence of Skyrmions within a FeGd sample. The purpose of determining the existence is to better understand how and why Skyrmions form for practical applications in everyday use.

Jan Perez
Universidad de Puerto Rico-Mayaguez
Title: Physics for everyone
Session #: 2
Poster #: 129

My poster will focus on the different fields in which physics can be applied. Physics is undoubtedly a complicated and complex field, and hard to understand most of the time. Despite this, it is able to be broken down and applied to the most fundamental aspects of life, and my goal is to demonstrate that, at its core, physics is a field in science for everyone.

Ruhi Perez-Gokhale
University of Maryland
Title: A Study of Radiation Damage of Plastic Scintillators
Session #: 2
Poster #: 120

Plastic scintillators are the material of choice in high energy physics to build detectors which measure the energy of particles, because they are inexpensive and can take any shape. However, radiation-induced damage of plastic scintillator is a concern: the light output of the scintillator decreases as it is exposed to the ionizing radiation produced by particle accelerators. We present a study of the radiation damage as a function of the dose rate in scintillators with varying concentrations of their components (base material, primary and secondary dopants), and investigate the possibility of mitigating the damage by illuminating irradiated scintillators with visible light.

Heather Perkovich
Texas Lutheran University
Title: Creating Physics Curriculum Outside of the Traditional Classroom Setting
Session #: 1
Poster #: 83

Physics Unlimited is an non-profit organization led by graduates of Princeton University, with many different aspects to the organization. Physics Unlimited's Moonshot Program is a new initiative designed to target underrepresented audiences and inspire them to become interested in physics. In a 7 week period, we designed and developed curriculum for 12 physics lessons, which will be taught over the course of 12 weeks in a one hour session each week. Each lesson is uniquely designed to capture physics in everyday life to make physics a relatable topic to every individual. As a content creator of the physics lessons that will be used in the coming months (and in the future), I was challenged to create appealing lessons to the intended audience. The School of Re-Entry at the Boston Pre-Release Center (BPRC) helps inmates prepare for life outside of prison and educates students in a diverse range of subjects, providing a new path in life. The pre-release center in Boston will be the first place where our physics lessons will be used, with the intention that the program will expand to include other similar centers and different target audiences across the U.S.

Jonathan Perry
Towson University
Title: Classroom Simuation of Gravitational Waves from Orbiting Binaries
Session #: 1
Poster #: 63

Demonstrations using stretched spandex fabric as a stand-in for curved spacetime can convey some of the wonder of general relativity to non-experts. We have extended this idea to build a simple and inexpensive simulation of gravitational waves from orbiting binaries, using a pair of caster wheels attached to a hand drill and illuminated by a strobe light. This setup successfully reproduces the pattern of outgoing spiral ripples that has entered the public imagination through LIGO animations. We use a paperclip plumb bob to measure the amplitude of these two-dimensional spandex waves as a function of orbital frequency, separation distance between the orbiting masses, and distance from the center of mass. We compare our results with those that hold for gravitational waves propagating in three-dimensional space.

Thomas Peters
Rhodes College
Title: Electrostatic Interactions of Charged Spheres
Session #: 1
Poster #: 69

We study the electrostatic interaction of two charged conducting spheres of arbitrary sizes. We derive two different expressions for the capacitance coefficients. One closed-form expression involving the special q-digamma function and one in the form of an asymptotic expansion. We can then approximate the asymptotic expansion to obtain simple capacitance expressions which are accurate when the spheres are close.

Noraya Pettiway
Siena College
Title: Turbines: A Wind-Wind Situation
Session #: 2
Poster #: 63

Two table top wind turbines were built to prove how substantial wind power can be. There are many health and economical benefits to using wind power over electrical power. Therefore two wind turbines were built to the same dimensions, but functioned differently; one standing still in one direction, while the other was able to swivel 180°. The turbines were made to hold a 12V, 200RPM, DC motor and carbon propeller blades. The voltage, current, and power were measured through a load, using the Vernier Energy Sensor Interface. The power produced from the turbines was then compared with the wind data from the weather station on campus.

Dung Pham
Worcester Polytechnic Institute
Title: Entanglement spectroscopy for composite quantum wires
Session #: 2
Poster #: 113

Spatial entanglement arises in semiconductor systems when particles are localized in proximity, which makes their spatial correlation crucial to accurately characterizing the system. An in-depth understanding of quantum spatial entanglement is therefore essential to the designing and fabrication of quantum computing devices. In this study, a fully variational formulation for calculating accurate few-electron wavefunctions in configuration space is developed and applied in investigating entanglement of two electrons in superlattice nanowire structures. We study the dependence of entanglement in various physical setups and introduce a detailed profile of entanglement "spectroscopy" in nanowires. Resonant behaviors associated with level crossings and/or the formation of electron clusters are observed. We also show that precise tuning of the entanglement can be achieved with applied electric fields. The results obtained for nanowires are generalizable for 2D and 3D quantum dots. Further, the tunability of entanglement via external fields provides control during quantum information operations and possibilities of new quantum bits.

Lia Phillips
Appalachian State University
Title: Spectroscopic Characterization of Functionalized Graphene Nanoplatelets
Session #: 1
Poster #: 144

In this research, the topographies, crystalline structures and chemical composition of pristine and functionalized graphene nanoplatelets (GnPs) were studied. Six separate functional groups (argon, ammonia, carboxyl, fluorocarbon, nitrogen, and oxygen), along with pristine graphene nanoplatelets, were spectroscopically characterized via Raman spectroscopy, X-ray diffraction spectroscopy, and a Scanning Electron Microscope. By implementing Support Vector Machine (SVM) learning algorithms, it was possible to successfully differentiate between the pristine graphene and the nitrogen and ammonia functionalized GnPs. From this base program, it is envisioned that additional functional groups can be differentiated, as well as specific GnPs identified that can detect toxic gases, thereby leading to the development of sensitive chemical sensors for such gas molecules. ________________
Financial support from the REU Site in Physics at Howard University from the National Science Foundation (Award # PHY-1659224) is gratefully acknowledged.

Sariah Phipps
Brigham Young University-Idaho
Title: Creating Opportunities for Others Through Outreach Programs
Session #: 1
Poster #: 42

For over one hundred years, The Optical Society has worked to promote the generation, dissemination, and application of knowledge in optics and photonics. OSA serves the global community through content and events that are authoritative, accessible, and archived, and through its education, advocacy and outreach programs. This summer, I have had the opportunity to work directly with the outreach team and learn about all the behind-the-scene practicalities that go into running outreach programs. During my time here, I was able to strengthen my skills in event planning, organization, proof reading, and team management through the various tasks I was assigned. These tasks included rewriting the career section and lesson plans on the Optics4Kids website, organizing travel info, meal plans, and housing for OSA's Siegman School, proof reading and publishing OSA blog posts, and much more.

Andrew Phipps
Brigham Young University-Idaho
Title: Diversity in Physics Definitions and Statistics
Session #: 1
Poster #: 43

This summer the process of acquiring data from the federal database (IPEDS) was streamlined to make it easier for future interns and employees at APS to analyze and discuss where the Physics community stands in terms of diversity in academia. Updating the APS Education and Diversity statistics follows a strict set of instructions that presents data from a consistent source and filters out any inconsistencies. These instructions are based off of APS' definition of Physics and the IPEDS database and take a considerable amount of time to sort through before APS proceeds to analyze it. This presentation will dive into the definition of Physics used by APS and the importance of what that data represents, as well as the effect it has on the physics/science community as a whole.

Caeley Pittman
William Jewell College
Title: Improving trigger efficiency for di-Higgs searches at center-of-mass energy 13 TeV with the ATLAS detector
Session #: 2
Poster #: 26

The Higgs self-coupling is one of the primary properties of the Higgs remaining to be measured. If its value deviates from the Standard Model prediction, it could provide a useful route for exploring physics beyond the Standard Model. The Higgs self-coupling is correlated with the cross section of di-Higgs production, so we aim to improve the analysis method for measuring this cross section. In this study, we demonstrate that adding b-jet and missing transverse energy (MET) triggers to the standard single and di-lepton triggers increases the total trigger efficiency for the signal by around 8% in the HH -> bbll?? search. This presentation will discuss the foundational physics involved in this project, as well as the methods employed to improve the efficiency of the analysis.

Charles Premo
Siena College
Title: NMR Spectrometer with Arduino Microcontroller
Session #: 2
Poster #: 78

Modern nuclear magnetic resonance (NMR) spectrometers are expensive to buy and maintain. We have put together an affordable to build spectrometer for nuclear magnetic resonance measurements in the Earth's magnetic field through using Carl A Michal's schematic for the circuits contained in the NMR spectrometer. An Arduino microcontroller replaces the most expensive components found in modern NMR spectrometers by acting as the pulse programmer, audio-frequency synthesizer and digitizer. Other expensive components include the superconducting magnets that are used in most modern NMR spectrometers to obtain the high frequencies and magnetic field strength necessary for detailed information of a sample. Our spectrometer does not need a superconducting magnet because it is focused on NMR measurements in Earth's magnetic field, which is used in place of the superconducting magnets. This in turn delivers much less information about the sample due to the lack of magnetic field strength in the Earth's field, as well as its low frequency, as compared to the larger magnetic field strength generated by the superconducting magnets and the high frequency operation of modern NMR spectrometers. We aim to implement this spectrometer in a teaching lab to demonstrate the principles of NMR spectroscopy through a hands-on approach, which will allow students to explore the many possibilities of low-

frequency NMR spectroscopy in Earth's magnetic field. A sample of ocean and deionized water is used to demonstrate the different pulse programs sent through the microcontroller and their respective NMR spectrums.

Jude Quintero
Randolph College
Title: Tuning PID Controllers Using Relay Feedback: RelAPro
Session #: 1
Poster #: 129

PID controllers are central to the functioning of processes in all aspects of society. Everything from the cruise control in your car to the functioning of complex industrial systems can be controlled by PID controllers, which are so widely implemented because of their versatility and simplicity. Each PID controller needs to be "tuned" so that it will function properly. The selection of tuning parameters has been the focus of great quantities of research, and several methods for manual and automatic selection have been proposed. The focus of research performed during an internship at Southern Air, Inc. was on the implementation of the Relay Autotuning algorithm for tuning PID controllers. A Relay Autotuner program was created and implemented in the Tridium Niagara AX JAVA environment. This Relay Autotuner Program was tested at the Amherst County High School in Amherst, Virginia, and produces accurate and repeatable results.

Keeran Ramanathan
University of the Sciences
Title: Undergraduate Student Measurements of Differential Conductance in P-Doped Iron Pnictides at 2K and Above
Session #: 1
Poster #: 72

We present results of low-temperature conductance measurements of the energy gap of P-doped iron pnictide superconductors. Certain superconductors, such as the iron pnictides, can exhibit multiple energy gaps depending on their growth conditions. Said energy gaps are often anisotropic relative to the crystal lattice structure of the pnictides, with some gaps primarily conducting parallel or perpendicular to the c-axis of the lattice. We discuss the methods of point contact spectroscopy (PCS) we use to create the samples we test, as well as the laboratory infrastructure our undergraduates have developed over time. Our goal is to obtain differential conductance data on variously-doped pnictide crystals, and contribute to the understanding of the various energy gap structures observed in these superconductors. We gratefully acknowledge support from the National Science Foundation grant DMR #1555775 and the Charles Kaufman Foundation.

Jorge Ramirez
University of Maryland
Title: Optical Cavity Inference Techniques for Low Noise Interferometry
Session #: 2
Poster #: 95

Gravitational waves are being detected more and more frequently by the Advanced LIGO interferometers due to the improvements made to their precision, to the rate of about one event per week. To improve the rate at which we detect gravitational waves, one method would be to reduce the noise that is intrinsic to the signals we receive from the interferometer, so that more events can be extracted from the data with confidence. To achieve this, a deeper understanding of the noise couplings that mask these signals is necessary. This project seeks to develop statistical methods of analyzing diagnostic signals field from Fabry-Perot cavities, and recovering otherwise difficult to measure parameters which govern these noise couplings using interferometer modeling software, Bayesian inference techniques, and Markov Chain Monte Carlo techniques.

Adam Ramker
University of Northern Iowa
Title: Building a Sample Holder to Measure Conductivity in situ
Session #: 1
Poster #: 134

We engineered a device to measure the resistance of thin film materials in situ as a function of thickness and growth temperature. The device was tested by depositing Au onto MoS_2. The Au was thermally evaporated in a high vacuum chamber as the MoS_2 was heated up to anywhere between 0-300 C. With this setup we were able to record the rate of deposition, the deposition temperature

of the substrate, and the overall sample resistance in real time. This device will allow us to further understand conductive properties of a variety of different materials at the nano-meter scale. These pieces of data can be interpreted by comparison to their atomic topography using scanning tunneling microscopy.

Zainab Raza
Siena College
Title: Building a Blood Droplet Impact Angle Apparatus
Session #: 2
Poster #: 62

Forensic scientists are able to use blood stain patterns to analyze which direction the path of the blood droplet was at the instant of the impact. These patterns can be recreated by dropping the fake blood drops from various angles in order to create the elliptical pattern which determines direction. This information can help to piece together a crime scene and even prove or disprove theories. The aim of this project was to help Siena College students get a better understanding of the way blood drop analysis works by creating a lab apparatus for that purpose. This apparatus has a dropper with adjustable height and a piece which moves at various degree increments in order to see what shapes the blood takes in these conditions. There are different materials that can be attached to analyze the difference in stains. The results can help students get a good understanding of how these variables play a part of blood stain analysis.

Isaiah Richardson
Old Dominion University
Title: Production of Nuclei on the Proton Dripline
Session #: 1
Poster #: 85

Proton-rich nuclei at the proton dripline have been produced at beam energies of $>$77MeV/u at facilities such as GANIL and NSCL at Michigan State University. At Texas A$\&$M, our goal is to produce these proton-rich nuclei at energies around 40 MeV/u with beam from the K500 cyclotron, and separate these nuclei using the Momentum Achromat Recoil Spectrometer (MARS). We used a spectrometer simulator, LISE++, to devise an experiment with a ^{40}Ca beam at 40 MeV/u on Be, Al, and Ni targets to determine how to optimally produce ^{35,36}Ca. We tuned MARS to the parameters LISE++ predicted to see how much of these exotic nuclei we could produce in experiment. The products were detected with a ΔE vs. E Si telescope to determine the yield of each isotope. It was concluded that at this energy, the Ni target had the highest production rate for the nuclei close to the proton dripline. The comparison between the experimental production rates and the production rates LISE++ predicted will be presented.

Helena Richie
University of Pittsburgh
Title: Survey of Transiting Extrasolar Planets at the University of Pittsburgh
Session #: 2
Poster #: 33

STEPUP is an undergraduate research group lead by Helena Richie with the goal of discovering new exoplanets using transit photometry. By conducting observations using the 16” Keeler telescope based out of the Allegheny Observatory in Pittsburgh, PA, STEPUP is able to collect and analyze photometric data on planet candidate targets to draw conclusions about the existence of the planet. To process our data, we use STEPUP Image Analysis (SIA), an image analysis routine developed by Helena Richie that is responsible for calibrating, plate-solving, and performing absolute differential photometry on the datasets. In the past, we have done work to contribute to data platforms such as the Exoplanet Transit Database, the American Association of Variable Star Observers, and publish unknown planetary parameters by collaborating observation. Currently, STEPUP is focusing its efforts on contributing data to the Transiting Extrasolar Survey Satellite (TESS) collaboration as members of the TESS Follow-up Observing Program Sub-Group 1 (TFOP SG1), which consists of seeing-limited photometric observers that do follow-up observations on TESS planet candidates (PCs) to weed out false positives.

Joel Ricker
Southeast Missouri State University
Title: Design and calibration of a custom force acquisition module for a Thor Labs Modular Optical Tweezers Kit
Session #: 1
Poster #: 145

Using an OEM four quadrant photodiode and a Raspberry Pi (RPi) minicomputer, we designed and calibrated our own custom force acquisition module for a Thor Labs Modular Optical Tweezers kit. The Thor Labs Modular Optical Tweezers kit includes modules for the optical trapping system, 976 nm Trap Laser, inverted light microscope, 3-axis Piezo activated stage, and a force acquisition module that is sold separately for $3500. The total cost of our custom designed module costs less than $300 and utilizes 3D printed housing. Sensor outputs are amplified and processed using TLC2264 OpAmps, digitized using an MCP3008 ADC, and sent to the RPi's GPIO for acquisition. A Python script is used to collect the x and y displacement from the RPi's GPIO and then converted to an absolute displacement. The optical tweezers trapping coefficient is computed using a fluid drag test to calibrate bead displacement to applied force in Newtons. We present our acquisition circuit, code, and calibration results.

Spencer Riley
New Mexico Institute of Mining and Technology
Title: Atmospheric Precipitable Water and it's Correlation with Clear Sky Infrared Temperature Readings: Data Analysis
Session #: 1
Poster #: 33

Precipitable water can be defined as the total amount of water vapor that exists in a vertical column of air, traditionally measured via radiosondes. Global Positioning System (GPS) networks and microwave-infrared radiometers can also be used to measure precipitable water by analyzing signal delay; these methods are used by NOAA. Precipitable water measurements can be used to forecast extreme weather events and the potential for precipitation. Based on a previous that analyzed the relationship between precipitable water and zenith sky temperature using infrared thermometers, we have developed a rigorous computational utility to study this same correlation for the Socorro, NM climate system. This research highlights the impact of using low-cost instrumentation to accurately forecast precipitation in regions where the data is not available. After thirty-five weeks, the results of our analysis show an exponential correlation ($R^2 = 0.707$) between precipitable water and clear sky temperature, similar to the trends found in previous studies. However, as we continue to collect data, the intrinsic properties of the correlation are continuously evolving. With the availability of our computational tool, we aim to widen our data to include a diverse set of climate systems to further study the relationship between clear sky temperature and precipitable water while also continuing to collect data for the Socorro, NM area.

Craig Roberts
Rowan University
Title: Dual Laser Frequency Locking using Modulation Transfer Spectroscopy
Session #: 1
Poster #: 115

Doppler-free excitation of atomic rubidium to Rydberg states can be achieved through resonant, three-step laser excitation. To this end, we are building a system to stabilize three lasers to specific atomic resonant frequencies. We use modulation transfer spectroscopy (MTS) to simultaneously frequency-lock two lasers in a setup with a single modulated pump beam. This effectively halves the instrumentation needed to frequency-lock the first two steps of the excitation path. We stabilize a 780-nm diode laser with our hybrid MTS system and simultaneously demonstrate an error signal for a 1529-nm laser. We are currently characterizing this error signal; general optimization of the system will include minimizing the crosstalk between error signals for the two lasers.

Sophie Roberts
University of Northern Iowa
Title: Automated Tip Etching for the Scanning Tunneling Microscope
Session #: 1
Poster #: 118

Commercial scanning tunneling microscope (STM) tips are expensive and manual etching procedures may lack reproducibility. This work describes an Arduino-based circuit and C++ program used to automate the etching of tungsten STM tips. A control circuit and software were developed to monitor voltage during the electrolytic etching process and halt the process when it was complete. Preparation of tips can be completed in around five minutes. Tips prepared by this method have been used successfully to acquire images of the surface of palladium. Using this method, laboratories can prepare their own tips rapidly and reproducibly, potentially reducing costs.

Alanis Rodriguez-Diaz
University of Puerto Rico Mayagüez Campus
Title: The Effect of the Expansion of the Universe on Different Types of Galaxies
Session #: 2
Poster #: 136

A galaxy is a system of stars, gas and dust held together by gravity. They are classified as dwarf, spiral, barred spiral, elliptical and irregular. If the universe keeps expanding, how will it affect them? The expansion of the universe is when the galaxies are moving away from us. Since there are different types of galaxies, the results are expected to be different according to the type. Does it affect its distance? This research helps us understand how the different types of galaxies change as the universe is expanding and how it affects them.

Wade Roemer
University of Louisville
Title: An MCMC Model of Host Galaxy Dust Attenuation
Session #: 2
Poster #: 114

Extinction, or light obstruction, caused by dust is a tedious problem to work around in astronomy. Devising a model to eliminate extinction in Type-1a supernovae (SNIa) can help us to eliminate error in the Hubble Constant since they are often used to construct a "distance ladder" in cosmology. This model will be derived on a statistical basis in order to predict the amount of extinction that occurs. The statistical model is expected to depend on some of the major characteristics of the SNIa in its host galaxy: radial distance, disc inclination, redshift, level of star formation, and others. We seek correlations between these various parameters in relation to the amount of extinction for SNIa. If our model is sufficiently conclusive, it could lead to a more accurate measurement for the accelerated expansion of the universe. We use the Bayesian statistical analysis of MCMC to build this model.

Orlando Romeo
University of Maryland-College Park
Title: Seasonal Variability of Waves near the Proton Cyclotron Frequency Upstream from Mars
Session #: 2
Poster #: 90

The magnetometer (MAG) onboard the Mars Atmosphere and Volatile EvolutioN (MAVEN) spacecraft has detected electromagnetic plasma waves upstream of the Martian bow shock, with frequencies near the local proton cyclotron frequency. The presence of these waves, often referred to as Proton Cyclotron Waves (PCWs), constitutes an indirect signature for the existence of planetary protons resulting from the ionization of Martian exospheric hydrogen. This study characterized the dependence of several wave properties and the occurrence rate of PCWs on different planetary and solar wind parameters utilizing MAVEN MAG data. In order to detect these waves, amplitude spectra of different magnetic field components were computed and applied to an automatic routine to determine a significant power increase near the local proton cyclotron frequency. Minimum Variance Analysis was then performed to estimate the direction of propagation and amplitude of the identified PCWs. The results from this research confirm a previously reported seasonal dependence, where the occurrence rate of these low frequency waves was higher near the Martian perihelion, while significantly lower rates were found when Mars was closer to aphelion. Future analysis implementing Solar Wind Ion Analyzer data will help to better characterize the conditions under which more free energy is present related to non-Maxwellian proton velocity distribution functions to generate PCWs, and its implications for the properties of the Martian hydrogen exosphere.

Nolan Roth
High Point University
Title: Effects of Carbon Nanotube Forest Patterning on Field Emission Properties
Session #: 2
Poster #: 49

The Mini Electron Probe Micro Analyzer (MiniEPMA) project aims to create an instrument capable of mapping the elemental composition of a mineral target on an airless body (e.g. a comet, asteroid, or moon). The instrument will use field emission between a cathode, chips set with a 10 by 10 addressable array of carbon nanotube (CNT) forests, and an anode, a grounded grid, to generate electrons. Those electrons will then be further accelerated onto the surface of the sample, exciting X-rays characteristic of the elemental composition of that surface. The X-rays can be measured using a silicon drift detector to give the surface composition of the region illuminated by the electron beam from each CNT forest. From this, we will be able to produce a fine-scale map of the

elemental composition. Still in early testing phases, the project's current goal is to characterize CNT emitters of various growth properties and geometries based on their emission properties, optimizing for high current output and low turn-on field.

Nathaniel Rowlands
Abilene Christian University
Title: Analysis of Hodoscope Efficiencies for E1039/SpinQuest Spectrometer using Cosmic Rays
Session #: 1
Poster #: 89

SpinQuest (E1039) at Fermi National Accelerator Laboratory is trying to help understand the spin structure of the nucleon sea using the 120 GeV proton beam and polarized NH$_{3}$ and ND$_{3}$ (ammonia) solid targets to provide the polarized hydrogen and deuterium. It uses the Drell-Yan process to access the nucleon sea via quark-antiquark pairs annihilating into a virtual photon, which decays into a μ^+ μ^- pair. Scintillator hodoscope planes provide the primary trigger, so understanding their efficiency is critical for the science goals of SpinQuest. This is achieved by counting the number of single track events that hit all eight planes vs the events with hits in seven or fewer planes. The goal is to have 99$^{\%}$ efficiency for every hodoscope plane. Initial studies of this technique are being done using cosmic rays. This analysis will measure efficiencies for single muon events. Thus a verified technique of measuring hodoscope efficiencies will be in place when SpinQuest begins engineering runs by November, 2019 and data taking by early 2020.

Javier Rufino
University of Texas at San Antonio
Title: Computing Momentum Distribution of Nucleons in Isospin Asymmetric Nuclear Matter
Session #: 1
Poster #: 139

Neutron stars are the densest observable objects in the universe with a mass and radius ranging between 1-2M? and 9-14km. Neutron stars consist primarily of neutron-rich nuclear matter in a background of ultra-relativistic electrons and maintain their stability against gravitational collapse due to the support from quantum mechanical degeneracy pressure and nuclear interactions. In this work we investigate the single-particle nucleon momentum distribution in neutron-rich matter up to twice nuclear saturation density. We compute from chiral effective field theory two- and three-body nuclear forces the first- and second-order contributions to the nucleon self-energies, from which the single-particle momentum distributions of protons and neutrons can be computed. We explore the dependence of the momentum distributions on the density and isospin asymmetry and compare to recent experimental results.

Griffin Running
Central Washington University
Title: Runaway Stars as a Possible Source of the Elliptical Ring Structure in NGC 7538
Session #: 2
Poster #: 8

Previous work by Central Washington Alum Jason Arakawa led to the discovery of an object that could have been a progenitor of a large ring of gas and dust in the high-mass star forming region NGC 7538. The Advancements in telescope technology and instrumentation since the time of Arakawa's work have allowed for the detection of many more possible candidate stars in the surrounding region. Specifically, O- and B-type stars are considered due to the fact that stellar wind strength and main sequence lifetime of these stellar classes are consistent with a ring of this size scale. This work aims to use SIMBAD data to determine if any of these new stars could have originated in, and possibly produced, the observed ring structure.

Damian Rupp
Colorado State university
Title: Sky Brightness Measurements at the Colorado State University
Session #: 2
Poster #: 24

This past summer a second-generation sky brightness meter (SBM) developed by the Global Network of Astronomical Telescopes (GNAT) consortium has been installed at the Colorado State University for the purpose of monitoring the sky brightness over the CSU-Fort Collins area. Details of that effort and some preliminary results obtained from this instrument are presented.

Catherine Ryan
The Pennsylvania State University
Title: The History of Our Knowledge of Black Holes
Session #: 1
Poster #: 39

Based on an exhibit at the Niels Bohr Library and Archives, The History of Black Holes: Or to Physicist, The History of Our Knowledge of Black Holes. Black holes are now a common object in sci-fi television and movies. While just 40 years ago they were still an inconceivable part of the anatomy of space. This presentation high lights the human element of physics research. Research of black holes has been affected by not just the limitations of physics and math infrastructure but by small-mindedness and war. The purpose of this poster is to shed light on the history of one of the most popular phenomena in physics. With a special focus on the events that did not occur in a lab or a lecture but often were a small collection of scientists discussing a topic that puzzled them for decades.

Sheila Sagear
Boston University
Title: Machine Learning Improvements to the CMS Trigger System
Session #: 1
Poster #: 133

The Large Hadron Collider at CERN is the world's most powerful particle accelerator. Data from its proton-proton collisions is collected by the Compact Muon Solenoid detector (CMS) and is used to search for new physics phenomena, such as new particles that may be dark matter candidates. CMS produces hundreds of terabytes of data every second. It is impossible to store this much data, so the CMS trigger system vets out less interesting and valuable data. This system must make extremely fast decisions on which pieces of data to discard and keep. We have been able to improve the way the trigger system recognizes the trails of different types of particles ("jet tagging") with machine learning, and can implement these improvements in a piece of hardware called a field-programmable gate array (FPGA). We continue to improve jet tagging with machine learning techniques. We optimize binary and ternary precision neural network models, synthesize them for integration into FPGAs, and measure their accuracy and efficiency. We show that binary and ternary jet tagging models are as accurate as floating point precision models, and they tend to perform with satisfactory speed and low resource usage in FPGAs.

Roy Salinas
Abilene Christian University
Title: Monte Carlo Simulation Studies for Unfolding Hadron-In-Jet Multiplicity Measurements at STAR
Session #: 1
Poster #: 49

Hadronic jets are among the most striking phenomena seen in high energy physics,but the conversion of scattered quarks and gluons into hadrons remains mysterious. The multiplicities of hadrons in jets have been proposed as a way to gain a deeper insight into fragmentation functions, in particular for the gluon. The STAR experiment at Brookhaven National Lab has long used spin asymmetries in jet production to constrain such things as gluon helicity. Recent studies have made use of spin asymmetries of pions within jets to investigate transversity and the Collins fragmentation function. Analysis of unpolarized hadron-in-jet measurements can lead to new information such as better constraints on the gluon fragmentation function and a clearer picture of the transverse momentum distribution of hadrons within jets. Producing accurate multiplicity measurements requires a multidimensional unfolding to correct for eects such as bin migrations for which Monte Carlo simulations have proven to be an eective tool. The status of a Monte Carlo analysis will be shown, along with a discussion on possible unfolding techniques.

Amber Sammons
Illinois State University
Title: Effect of supplementary videos on scientific reasoning in a general physics course
Session #: 2
Poster #: 14

This study investigated the impact of an instructional reform on student scientific reasoning skills and general attitudes toward science. The intervention was administered via eight 5-7 minute videos during lab. Each video consisted of an explanation of its targeted concept, a hands-on demo with observations and YouTube clips highlighting the topic being discussed. While viewing the videos, students were required to answer specific questions testing their comprehension of the concepts and the scientific reasoning being displayed. Lawson's Scientific Reasoning Test was administered to assess improvement in student scientific reasoning skills, and the CLASS was used to assess changes in student attitudes towards science. Pre and Post-test results are compared for a control semester and semesters with this new teaching method. Results show that this video intervention, which took students about two hours in total to complete, significantly improved students' science reasoning skills and their attitudes towards science.

Nicholas Sanders
California State Univ - Sacramento
Title: Why is the Luminosity Function of Short Gamma-Ray Bursts a Broken Power Law?
Session #: 1
Poster #: 125

Bursts of gamma-rays are emitted from relativistic jets born from neutron star mergers. These are called short Gamma-Ray Bursts (sGRBs). The number of sGRBs can be plotted as a function of luminosity, which we refer to as the "luminosity function." Using observations from the Neil Gehrels Swift satellite, different studies have shown that the number of sGRBs decreases as their luminosity increases. More specifically, these studies find that this function is a broken power-law and our main goal is to answer why is this the case. Two explanations for this function's nature were explored: the sGRB jets angular-dependence and possible propagation effects as sGRB jets are ejected, which we hypothesized that would turn a single power-law function into a broken power-law one. Our calculations have shown that these two explanations are not sufficient in describing the observed behavior of the luminosity function. This suggests that the broken power-law luminosity function is an intrinsic property of sGRBs. Our exploration of this option have led us to calculate the effects of mass accretion rates and spin parameters of black holes in neutron star mergers.

Victoria Sanzone
David Lipscomb University
Title: Optical Confirmation of Galaxy Clusters
Session #: 2
Poster #: 7

It is important to produce a galaxy cluster catalog in order to better understand the structure formation in the universe and to impose stronger constraints on cosmological models. The Swift AGN and Cluster Survey (Dai et al. 2015) as well as the Dark Energy Survey (DES) were used to optically confirm the presence of galaxy clusters by observing the data from the DES in a range around cluster candidates given by the Swift Survey. Optical data from the DES in the source region was compared to that of the background region such that there was a 2? significance to the reported results. We were able to optically confirm the presence of 45 galaxy clusters out of 75 cluster candidates out of 442 from the Swift cluster catalog that lie within the footprint of the Dark Energy Survey Data Release 1. Other studies have previously confirmed clusters from the Swift cluster catalog in other regions of the sky using data from the Sloan Digital Sky Survey, the MDM Observatory, KPNO, and Pan-STARRS. Non-detections are assumed to be clusters that exist outside of the visible spectrum data that was provided in the DES. These results will make galaxy cluster catalogs more complete for use in the study of cosmological models.

Andrew Scherer
Cleveland State University
Title: Using Depolarized Dynamic Light Scattering to Study Microgel Volume Phase Transition
Session #: 1
Poster #: 32

Microgels, for the purpose of this study, are hydroxypropyl cellulose, (HPC) particles suspended in water. These microgels exhibit a thermally reversible volume phase transition as a result of the amphiphilic properties of the parent polymer. Specifically, the microgels deswell above a volume phase transition temperature, T_trans. Microgel dynamics below and above T_trans have been studied extensively by dynamic light scattering (DLS) before. Here, HPC microgel shape fluctuations and/or geometric anisotropy is investigated through the technique of depolarized dynamic light scattering (DDLS). The technique has previously been used in our lab to examine geometric anisotropies in nanorods, nanorice, nanodiscs and other shapes. It has also been used in the literature to study shape fluctuations in microgels that have a hard, polystyrene core and a soft, polymer shell ("core-shell microgels"). The current study shows that HPC microgels, consisting only of polymer with no built-in hard core, do exhibit a DDLS signal distinct from a polarized signal, both below and above the transition. The origin of this signal, which can arise from either geometric anisotropy or shape fluctuations, is being examined in detail for a series of microgels of different densities crosslinked at various synthesis temperatures. Preliminary results suggest that our samples undergo shape fluctuations, but further experiments are needed to confirm this.

Dylan Schmitt
Wheaton College
Title: Observations of the Galactic X-ray Binary System SS 433 using Chandra and NICER
Session #: 2
Poster #: 17

The Galactic X-ray binary system SS 433 is the only known astrophysical object to exhibit strong, relativistically red- and blue-shifted lines from elements such as S, Si, Fe, Ni. The X-ray emission lines originate in a jet outflow that is launched somewhere very close to the compact accretor, which is either a black hole or a neutron star. SS 433 was observed using the Chandra X-ray Observatory and the Neutron Star Interior Composition Explorer (NICER) mission during 2018 August 13-14th. These observations were made when the compact object was emerging from an eclipse behind the donor star. The observations were designed to take advantage of the eclipse to study the vertical structure of the jet. Here we present spectral analysis of the NICER and simultaneous Chandra data. We have modeled the emission lines observed in the spectra from both observatories using phenomenological models to estimate line properties such as the wavelengths of the line centers, line widths, fluxes, and redshifts. The high-quality Chandra X-ray spectra obtained using the High Energy Transmission Gratings Spectrometer also helps us to confirm the wavelength calibration of NICER.

Terance Schuh
The College of New Jersey
Title: Using Euler characteristics to understand nuclear pasta
Session #: 1
Poster #: 41

Although they are considered independent subjects at this moment in time, physics and mathematics have always been closely related to one another. As both fields have grown and the amount of people working in them has exponentially increased, the two subjects have naturally started to overlap more and more as a result. These overlaps are particularly important because they can lead to advances in fields that may not have occurred had the fields remained independent. In this work we are specifically interested in the crossover between astrophysics and topology. Topology and topological methods are surprisingly abundant in astrophysics. Because this abundance spans so far, we only focused on one area of astrophysics where topology plays a significant role. In this work we concentrated on a sub-field of astrophysics known as astromaterial science. Within that field we looked at a material referred to as nuclear pasta, called that because of its uncanny resemblance to everyday, edible pasta. Nuclear pasta resides within neutron stars and there are several different phases of it. Each phase is distinctly different from the others and has a unique underlying topology. The purpose of this work is to determine the Euler characteristic of each phase, a number that describes the topology of a certain shape or structure. Knowing this Euler characteristic is important because it can be used to provide us with some insight into nuclear pasta formation, but that is something we're still working on and is considered future work.

Joseph Schuster
Henderson State University
Title: Implementing Machine Learning in Sample Collection
Session #: 2
Poster #: 6

By utilizing machine learning algorithms a robotic arm can be able to grapple a wide variety of objects through a combination of basic geometric shapes. The first step in making the arm able to find objects and pick them up is training the arm to be able to pick up different sizes of cubes and depositing them into a collection bin to simulate reality. By utilizing a combination of pressure and range sensors in the tool frame and world view, the arm will be able to accurately determine where an object is and when the arm is in position to grapple an object. The world view component will be handled by a CE-30 C LIDAR, which will allow the arm to determine the distance of objects and their shape in the form of a 3d coordinate array, and then to maneuver the arm into the general area. The tool vision consists of sensors on the manipulator used to determine when the arm is in position and if the arm has a good connection to the object.

Kirsty Scott
Florida State University
Title: Study of Spin Glass Dynamics on the Mesoscale
Session #: 1
Poster #: 90

Spin glass is a disordered magnetic system. Our experiments use thin film Ge:Mn spin glass samples of glass transition temperature Tg = 24K and thickness L = 15.5 nm to study dynamical properties of lower dimensional spin glass systems. When the spin glass correlation length grows to the sample thickness, the spin glass state transitions from 3D to 2D dynamics. We use this spin glass dynamical transition to study the phenomenon of temperature chaos. After the dimensional crossover, a change of temperature can destroy the spin glass state when the temperature chaos correlation length grows to the sample thickness. Here the average distance between spins is 5.4 Å. From our data, we have estimated the temperature chaos critical exponent of 1.1, which matches well with theoretical predictions of 1.06. Moreover, we have created a magnetic field profile simulator in MATLAB to study the feasibility of experiments from 3D to 1D and 3D to 0D dynamical transitions. Acknowledgements: Financial support from the REU Site in Physics at Howard University from the National Science Foundation (Award # PHY-1659224), along with support from the PI, Dr. Prabhakar Misra, Department of Physics & Astronomy, Howard University, Washington, DC, and experimental measurements facilitated by the Department of Physics, University of Maryland, College Park, MD, are gratefully acknowledged.

Robert Seaton-Todd
Davidson College
Title: Experimental Nuclear Structure Studies of Neutron-Rich Nuclei
Session #: 2
Poster #: 56

Modern nuclear physics concentrates heavily on exotic nuclei, which lie very far from the valley of stability on the chart of nuclides. Such nuclei exhibit unusual phenomena and provide an extreme test for models of nuclear structure. Radioactive beams are used to study the properties of neutron-rich nuclei out to the neutron drip line, particularly in a region known as the "island of inversion." The island of inversion is of interest because the nuclei in this region have been shown to undergo changes in nuclear shell structure, and the mechanisms driving these changes are not fully understood. An experiment at the National Superconducting Cyclotron Laboratory was conducted to better characterize the structure of these exotic nuclei, by populating neutron-unbound excited states in this region. The Modular Neutron Array, the Large multi-Institutional Scintillator Array (MoNA-LISA), cathode readout drift chambers, and the Sweeper Magnet were used to perform invariant mass spectroscopy to reconstruct the decay energies of populated unbound states. Results, including decay energies of select nuclei, will be discussed.

Gray Selby
Davidson College
Title: 10B(d,p)11B and 25Mg(d,p)26Mg Measurements using the Super-Enge Split-Pole Spectrograph
Session #: 2
Poster #: 123

Two experiments were preformed using the Super-Enge Split-Pole Spectrograph at Florida State University's John D. Fox Accelerator Laboratory to measure high-resolution spectra of states in ^{26}Mg and ^{11}B through the use of (d,p) single-particle transfer reactions. Spin assignment confirmation of five states above the proton threshold of ^{26}Si are necessary for assessing the astrophysical impact of the $^{25}Al(p,\gamma)$ reaction rate on the ^{26}Al cosmic abundance. We investigate $^{25}Mg(d,p)^{26}Mg$ as a mirror to ^{26}Al to assign spin to the mirrors to the states of interest. A previous study observed beta-delayed proton emission in the neutron-rich nucleus ^{11}Be with an unexpectedly high decay mode strength that can only be understood if the decay proceeds through a new single-particle resonance in ^{11}B strongly fed by beta-decay. A recent pre-print corroborates the study, providing the expected excitation energy. While the resonance in ^{11}B was not found, spin assignments of ^{11}B states were assigned, one of which was previously unassigned.

Rida Shahid
Davidson College
Title: Search for the Ground State of 15Be
Session #: 1
Poster #: 75

15Be is a unique nucleus because it is light and neutron-rich. It is expected to have two low-lying states, but previous searches have found only one state decaying by one neutron to 14Be. Searches using the two-proton knockout reaction from 17C did not find the low-lying states. 15Be is neutron-unbound and is predicted to decay in the three neutron-channel. This experiment uses the neutron pick-up reaction for 14Be to find the low-lying states in the three-neutron channel. Moreover, this work seeks to determine the ground state of 15Be by matching the decay energy spectrum determined through the experimental data with a sum of decay energies of states from 15Be, 14Be, and 13Be. Various combinations of simulations from states of 13Be, 14Be, and 15Be were scaled and summed to find the best fit for the decay energies and hit multiplicity. The results show that a 15Be state is necessary to describe the experimental data. This suggests that the ground state of 15Be might be around 0.30 MeV which was previously unknown.

Mark Sharp
Augustana College
Title: Fluorescent Biosensors and Calcium Waves in Tulane Virus Infected Cells
Session #: 2
Poster #: 138

Human noroviruses (HuNoVs) are enteric caliciviruses (CVs) that cause global diarrheal disease in all age groups. Treatment for these viruses costs more than 65 billion dollars annually. There are currently no therapeutics (i.e. antivirals or vaccines) to treat the disease, so current treatments target symptoms. The process for developing therapeutics for HuNoVs has been limited because no tissue-culture system has existed to study the virus until recently. To address this, my lab studies Tulane Virus (TV), a simian homolog to human noroviruses that retains genetic and biologic similarity. Ca2+ signaling is important to both healthy and infected cells, so we studied the way that Ca2+ moves in infected cells using a fluorescent biosensor to determine the mechanism of the virus infection. To determine how Ca2+ signaling changes in response to virus infection, we used live-cell Ca2+ imaging to quantify Ca2+ signaling. We determined that aberrant Ca2+ signaling during infection is caused by replication competent virus. We found that both Thapsigargin and BAPTA-AM decrease Ca2+ signaling. This finding indicates that ER Ca2+ stores are necessary for Ca2+ signaling. Together these findings show that intracellular Ca2+ is important for TV replication, and TV infection does induce aberrant host Ca2+ signaling. Since protein function within RNA viruses is often conserved, our findings in the enteric calicivirus TV may extend to HuNoVs. These findings suggest that limiting intracellular Ca2+ or creating small molecule inhibitors to viroporins could be a novel approach to create the first antiviral treatments for HuNoVs.

RileyAnne Sharpe
Centre College
Title: Modeling Optimal Operating Parameters of a Gas Electron Multiplier Particle Detector
Session #: 1
Poster #: 45

Using relativistic heavy ion collisions to study the properties of the quark gluon plasma requires particle detectors that can operate continuously with little to no dead time. One such detector is the gas electron multiplier (GEM). Optimization of a GEM detector requires maximization of gain while minimizing positive ion backflow. Gain must be maximized for a small number of primary electrons to be amplified to create a signal that can be read out by electronic sensors, while positive ion backflow must be minimized to ensure the electric field within the GEM is not distorted. In order to accomplish this, properties of different gas mixtures within the GEM, potential differences across the GEM layers, and the alignments between GEM layers must be optimized. These conditions are simulated using the finite element analysis software ANSYS to model the structure of a GEM and Garfield++ to depict the amplification of electrons moving through the GEM. These models can then be used to simulate different parameters to find the ideal operating conditions for the GEM detector. Results of these studies will be presented and discussed.

Pranjal Singh
Davidson College
Title: A Photometric Study Of RR Lyrae Stars Using Period-Luminosity Relationships
Session #: 2
Poster #: 44

RR Lyrae are low-massvariable starts that lie within the intersection of Horizontal Branch and Instability Strip. With pulsations periods of a few hours to a day, these stars can serve as an effective tool to calculate stellar distances. This investigation uses the 0.4 m telescopes of the Las Cumbres Observatory telescope network to conduct a photometric study of several RR Lyrae stars. Photometric data from the B,V, i, p, g, r, and z bands are used to construct light curves for each star that yield periods and apparent magnitude information for the target sources. The respective derived data combined with RR Lyrae metallicities [Fe/H] and theoretical period-luminosity (PL) relationships is computed to determine distances to the stars. These distances are compared to

those yielded by the GAIA DR2 survey to test the validity of the PL relation theory. In reporting the results for V, i, and z bands, we find that, in general, the distances derived using the current PL theory do well-match those determined by GAIA.

Kaleb Slaatthaug
Grove City College
Title: Synthesis of Gallium Oxide Nanowires
Session #: 1
Poster #: 7

We have been attempting to determine the optimal conditions for synthesizing gallium oxide (Ga_2O_3) nanowires atop silicon wafers (with a thin SiO_2 surface coating). To accomplish this, we place a gallium sample within a tube furnace and run nitrogen (N_2) gas through the system while it is heated to 1000° C. This causes the gallium sample to vaporize and be deposited upon the surface of the wafer, whereupon the gold plating functions as a catalyst, allowing the gallium to bond with trace amounts of oxygen (O_2) and form Ga_2O_3 nanowires via the Vapor Liquid Solid (VLS) process. We are currently seeking to control the precise flow rate of nitrogen through the tube furnace to better determine ideal synthesis conditions. Furthermore, we are also attempting to control synthesis by creating a pattern of gold dots on the wafer instead of coating the entire surface with a uniform layer. Initial results look promising.

Ian Slagle
Coe College
Title: A Genetic Algorithm for Fitting 10B NMR Powder Patterns
Session #: 1
Poster #: 59

A modified program for fitting 10B NMR powder patterns of crystalline and amorphous materials, by implementing a genetic algorithm, is presented. NMR parameters are of interest to glass science as they help examine the short and medium range order of glass. The program finds the closest fits for the quadrupolar coupling constant and the asymmetry parameter, and the widths of each parameter's Gaussian distribution. This program can be run through Google Colab on virtually any computer with an internet connection. Instead of the original brute force algorithm, this algorithm applies the principles of evolution, including mutation, crossing over, and selection. Instead of checking each parameter over an entire range, which is an $O(n^4)$ algorithm, the genetic algorithm can get produce excellent fits (low NRPs) in ten generations of ten individuals each. The original program relied on a library of generated spectra that is difficult to maintain and requires a large amount of storage. Due to this reliance, an artificial lower bound to the NRP was introduced. The new algorithm greatly reduces computational time and resources for fitting NMR spectra, while making it possible to obtain better fits. One-site fits have been calculated for amorphous B_2O_3 cooled at three different rates and crystalline lithium orthoborate. The amorphous B_2O_3 cooled at an intermediate rate saw similar coupling constants and asymmetry parameters as well as widths slightly larger than that of the original program (0.147 compared to 0.13 for the quantum coupling constant and 0.067 compared to 0.06 for the asymmetry parameter).

Sam Smiley
DePaul University
Title: Non-Contact Laser Ultrasound Development
Session #: 1
Poster #: 8

MIT Lincoln Lab and Massachusetts General Hospital are working toward the development of a non-contact laser ultrasound. The device has the potential to be low cost, portable, and safe, and can create high quality imaging. The device sends ultrasonic waves which travel through the tissue as mechanical waves. Using doppler vibrometry and a 1550 nm skin and eye safe laser, the device is able to measure reflected ultrasonic waves in the tissue to identify objects such as bone and tendons, based on the optical absorbency of the object. I worked to develop new system set-up, enabling me to acquire data using a collocated excitation laser and vibrometer. Additionally, we develop beam forming code to process the imaging data in a method similar to traditional ultrasounds that ideally has better resolution than traditional contact ultrasounds.

Cassady Smith
Whittier College
Title: Optical Coatings for use in Future Gravitational Wave Detectors
Session #: 2
Poster #: 89

We determine the effect of heat treatment steps on the upper (tantala/silica), lower (amorphous silica/silicon), and full stack mirror coatings for use in future gravitational wave detectors. This includes a full range of measurements at room temperature and establishing the setup for measurements at cryogenic temperatures. We find that heat treatment steps in increments of 100ºC does reduce the average lowest mechanical loss of each stack. The maximum reduction in coating mechanical loss for each stack is exhibited at 500ºC. The change from the as-deposited upper stack to the optimally heat-treated full stack exhibits a reduction in mechanical loss by approximately 56%. While this does produce a reduction in thermal noise from the coatings currently used, it is not reduced by a factor of two, as required by the aLIGO Plus upgrades. More work must be done to understand the effects of different depositions, treatments, and other methods used to reduce coating thermal noise for use in future gravitational wave detectors.

Brigette Smith
Coe College
Title: Europium 3+ and Terbium 3+ Doped Gadolinium BoroTungstate Glasses for X-ray Detectors
Session #: 2
Poster #: 107

High density scintillating glasses have a strong potential to be useful in x-ray detectors for medical imaging. In this study, known glasses composed of X Gd2O3 + Y WO3 + (1-X-Y) 2H3BO3 where if X = .25 then Y = .25, .35, .45 and if X = .20 then Y = .20 were doped with between 0-6% Europium or Terbium and prepared using a conventional melt-quench technique. Densities of these glasses ranged from 4.6 to 6.2 g/cm3. Raman studies show that the presence of Eu3+ and Tb3+ cause a change in the network structure and an increase in the formation of tungsten tetrahedra within the glass. Photoluminescence studies showed that the concentration of the scintillators in the glass had an effect on the ratio of intensity of luminescence bands within the spectra but no bands showed evidence of forming or disappearing. The glasses emission wavelengths overlap with the high quantum efficiency region of photo detectors and show competitive capabilities.

Francis Snyder
Saint Joseph's University
Title: Confocal Microscopy and Microrheology of Colloidal Gels
Session #: 2
Poster #: 16

By inducing a depletion attraction in a colloidal suspension, we can form a colloidal gel with a long ranging structure. It is this colloidal gel structure which is of interest to us. We can vary the strength of the depletion attraction making a stronger or weaker gel via varying the interparticle bonding strength. Once the depletion attraction is induced the gel responds differently to shearing depending on the strength of the interparticle bonding. By carefully observing how the gel responds to precisely applied forces we attempt to quantify the properties of the structure of the colloidal gel. By adding micrometer size magnetic beads to our sample and manipulating them we can learn about the structure and behavior of our samples. We employ both fluorescent and confocal microscopy to study the dynamics of magnetic beads and colloidal particles that make up the colloidal gel. Preliminary results indicate a strong relation between strength of the depletion attraction and the effective viscosity of our sample.

Rae Stanley
Marshall University
Title: Star Spot Distribution in Kepler YSAs
Session #: 1
Poster #: 16

The YSA Project is a long-term observing campaign with the goal of understanding the magnetic behavior of young stars and their impact on young planets.Early results indicate that these stars undergo cyclic behavior in which the standard deviation of spectral index changes from a high to low state over time.This is possibly due to changes in spot activity,from spots dominated by an "active region" to a more distributed spot pattern.If so,photometric measurements,such as those from Kepler,should demonstrate a similar pattern.Since spot activity is correlated with flares,understanding this behavior is important for the YSA project.In this work we are studying a larger sample of YSAs from the Kepler data in order to charactarize this behavior,and its implications for young solar systems.

Jason Starita
The George Washington University
Title: I CAN Science: An Outreach Collaboration
Session #: 2
Poster #: 140

I CAN Science is an outreach collaboration between The George Washington University's SPS chapter and Life Pieces to Masterpieces (LPMP) after school program. LPMP is a nonprofit dedicated to involving members in the arts, developing character, and practicing key academic skills for African American boys ages 3-25 who come from lower socioeconomic backgrounds. For the last six years, members of GW's SPS chapter have traveled to Drew Elementary School to engage in scientific inquiry with the boys. During the spring of 2019, our SPS outreach group taught seven distinct lessons on Friday afternoons in two of the LPMP classrooms for boys ages 7-12. The program materials were purchased using funds supplied by the Future Faces of Physics Award, the SPS National award dedicated to promoted physics across cultures. Throughout the program, learners had the opportunity to explore two to four different stations regarding that week's physical phenomenon of focus including astronomy, light, motion, and phase changes.

Samantha Staskiewicz
The Pennsylvania State University
Title: Field Notes from the House Science Committee
Session #: 1
Poster #: 78

As the news and communications intern for FYI: Science Policy News, I completed a wide range of assignments such as writing sections of weekly newsletters, tracking amendments to legislation, and reporting back to the team on important science policy events. My favorite events to attend were House Science Committee hearings which taught me a lot about how science is prioritized and discussed by elected officials. I authored a full-length article on a hearing that surveyed threats posed by melting glaciers and ice sheets, such as sea-level rise and disruption of water supplies. My presentation will focus on the details of this hearing, specifically the witnesses' recommendations to Congress on how to address the remaining knowledge gaps in the field.

Nicholas Stubblefield
Boston College
Title: Policy and Physics: A Strive for Mutualism and My Experience as an AIP Mather Intern
Session #: 2
Poster #: 2

Begun in 2009, the AIP (American Institute of Physics) Mather Public Policy Internship extends the opportunity for physics students to become involved in the public policy process both generally and as it specifically pertains to science, technology, and environmental issues. Traditionally, interns are placed in the legislative branch either working for individual Congressional members or assisting in the functions of Senate or House committees. The intent is to both expose technically skilled students to the formal processes of lawmaking and directly involve them in science policy work in the hopes this exposure encourages a professional commitment to politics in the future. This past summer, the internship made its first executive placement. I was assigned as a policy support staffer in the Office of Advanced Manufacturing at the National Institute of Standards and Technology (NIST). I present my experiences contributing to policy planning and implementation in an executive agency. I also discuss the nuances of the policy process, theories on the necessary conditions for successful disruptive policies, and I share how technical experts can participate in lawmaking.

Nick Sundstrom
Wheaton College
Title: Monte Carlo Modeling of Ion-Ion Energy Transfer Mediated by Surface Plasmons
Session #: 2
Poster #: 15

Energy transfer between donor and acceptor ions (or molecules) is a well-known phenomenon. In the energy transfer process, the donor-acceptor interaction is usually mediated by virtual photons. However in the presence of a metallic surface, donor-acceptor interactions may also be mediated by surface plasmons. For donor-acceptor pairs near a smooth planar metallic surface, the probability of surface plasmon-mediated transfer has been estimated to be much less than that of photon-mediated transfer, so that it would be experimentally challenging to observe the role of plasmons on the transfer process. With the goal of designing an experiment to directly observe surface plasmon-mediated energy transfer, we simulate plasmon-mediated energy transfer in a solid

using Monte Carlo methods. Using MatLab, we construct a solid doped with different concentrations of randomly placed acceptors and donors. We simulate the interactions between the donors and acceptors, define probabilities of photon emission and energy transfer, and plot donor decay curves. Our poster will contain the theory behind plasmon mediated energy transfer, the method and design of our simulated experiment, and some initial results showing how to unambiguously identify the role of surface plasmons in the energy transfer process.

Brittni Sutter
Grove City College
Title: Prediction of Non-valence Temporary Anion States of (NaCl)2
Session #: 1
Poster #: 14

Non-valence temporary anion states are notable because they can act as a ‘doorway mechanism’ allowing low energy electron capture to drive processes which would otherwise require hightemperatures or high energy electrons or photons. It is difficult to experimentally characterize these states since they have a lifetime between 1-100 femtoseconds. Computational modelingcan provide accurate energies and lifetimes of these states but require using extended basis (off-atom functions) and including electron correlation effects accurately. We used equation-of-motion coupled cluster (EOM-CCSD) calculations to predict the existence of a non-valence temporary anion state for NaCl Dimer. This molecule was picked because of its large quadrupole moment which binds an electron in an Ag orbital,suggesting the possibility of temporary capture in a B2u orbital. We used the stabilization method and analytic continuation to determine the resonance energy and lifetime. As well as predicting a non-valence temporary anion state for the NaCl Dimer, we showed the effect of correlating the core electrons of alkali metals was important to accurately characterize the temporary anion state.

Dan Swartz
Johns Hopkins University
Title: Self Assembly far from Equilibrium
Session #: 2
Poster #: 75

Many modern scientists are devoted to determining what general ideas, if not energy alone, we can cling to in statistical physics far from equilibrium. Center stage in this effort is the field of Stochastic Thermodynamics. In this framework, the game is actually quite different, trying to learn how can we use stochastic variables describe non-equilibrium systems. This approach has been quite successful. The main triumph being a new set of governing principles that systems which consume energy should abide by. First, there is no free lunch. Whenever you drive a system out of equilibrium, Entropy is always produced. Second, lunch is not price controlled. The faster and more precise the driving, the faster entropy is produced. The summary of my work is to look for this driving-entropy trade off in a sample model.

Victoria Tabibi
Old Dominion University-Physics
Title: Laser-based Remote Sensing of the Ocean Surface
Session #: 1
Poster #: 91

We will report progress on an experiment to detect light generated at the surface of natural waters via non-linear processes such as second harmonic generation of laser light. Both naturally-occurring compounds and pollutants that populate a microlayer at the surface of the water can contribute the observed signal. This method can be used, for example, to remotely detect oil slicks. Our project uses a Nd:YAG laser operating at 532nm as the light source. Photons created through harmonic generation will be detected with a photo-multiplier tube (PMT). We will be examining different types of natural water samples and compare our results to samples in which known chemical compounds are added to pure water. The ultimate goal of the research is to augment existing instrumentation for ocean research, such as oceanographic lidar that probes bulk properties of the ocean, with the additional capability of remote characterization of surface constituents. Such an instrument promises to expand research on the biogeochemistry of ocean waters.

Nolan Tenpas
Texas Lutheran University

Title: Automatic Querying of Rare Stellar Remnants

Session #: 1
Poster #: 119

Stellar remnants are the leftovers of stars that have progressed through their lifecycle. One type of remnant, known as a cataclysmic variable, includes a white dwarf accreting mass from a Main Sequence star. When the white dwarf has a magnetic field strength of more than 10 MG, and mass is accreted at a very slow rate (~10-14M¤/yr), it is known as a Low Accretion rate Polar (LARP). Only 9 LARPs are known and have been discovered by chance. In order to find more, and learn about the evolution of these unique systems, we developed an automatic pipeline to query 500,000+ stars from the All-Sky Automated Survey for Supernovae (ASAS-SN). Our pipeline also queried other surveys including XMM-Newton, WISE, and GALEX. We then determined filters using data from the nine known LARPs to compare to our sample. After being filtered out, the resulting objects had a higher probability of being a LARP. After running 500,000+ stars through our pipeline, we found 160 potential LARPs.This pipeline provides a way to identify potential LARPs as well as other unique stellar systems, to help understand these unique stars in a new way.

Brandon Thomas
California State University - Sacramento

Title: Track Reconstruction and Performance Analysis of the Pixel Detector in ATLAS Experiment at CERN

Session #: 2
Poster #: 85

In order to study the smallest objects in the universe, the ATLAS experiment at CERN uses multiple levels of detection media. Of these the closest to the proton beam-line is the Pixel Detector, a system of thousands of silicon modules with 46,080 readout channels per module, which records the position of charged particles passing though individual pixels. To interpret the vast amount of data collected by the Pixel Detector, researchers use neural networks to perform initial analysis and aid in track reconstruction. This process however is imperfect, and events are occasionally interpreted incorrectly. The goal of this project was to observe one such instance, in which charge clusters would be "split" into two or more particle hits by a neural network clustering algorithm. In order to do this, our team would build a ROOT based tool to visualize reconstructed tracks, and allow researchers to compare tracks to their charge distribution across individual Pixel Detector modules.

Doni Thomas
Rhodes College

Title: Recycling of Polyethylene Terephthalate

Session #: 2
Poster #: 134

PET accounts for 10.2% of the plastic produced worldwide and is nearly exclusively used for single use bottle packaging. Over the past few decades, recycling PET has become a major initiative around the world as result of increased pollution levels and climate change. Improvements in the reprocessing of recycled polyethylene terephthalate (rPET) for product applications will in turn diminish the demand for virgin PET and ultimately have a favorable impact on our environment. However, it has been challenging to reprocess the rPET because of the degradation of the rPET. The focus of this study is to address this issue and understand the effect that reprocessing has on the structure and the mechanical properties of rPET with different reprocessing conditions. The goal of this project is to study the processing potential of film stacking rPET water bottles within a compression mold to generate a mechanically sound rPET plate. Afterwards the plate will be cut into samples and prepped to undergo thermal and mechanical testing. Thermal testing involving differential scanning calorimetry (DSC) and Fourier-transform infrared spectroscopy (FTIR) will be used to determine structural integrity. Mechanical testing involving flexural, tensile and impact testing in accordance with ASTM standards will be used to determine the materials mechanical properties.

Darby Thomason
Kettering University

Title: Measurements of Atmospheric Physics with a Weather Ballon

Session #: 2
Poster #: 41

The Kettering University Physics Club built, launched, and recovered a weather balloon, which traveled in real-time using a radio transmitter. The balloon traveled 45 km from the launch location and reached an altitude of 35 km at its peak. The flight computer took measurements of atmospheric pressure, temperature, and speed as a function of latitude, longitude, and alttitude. A 360-degree camera was also used to acquire continuous video during the 3.75 hour flight and resulted in some stratospheric images of southeastern Michigan distinctly showing the curvature of the Earth. The measured profiles of temperature as a function of altitude were approximately consistent with the model of the U.S. Standard Atmosphere. *The authors would like to thank the Kettering University Student Government for financial support.

Justin Thompson
Cleveland State Univeristy
Title: Cloud Watching: Using Images to Analyze Shallow Cumulus Clouds
Session #: 1
Poster #: 37

The interaction between clouds and the environment is a driving force in climate models, and we are seeking to create techniques to analyze these phenomena. Total Sky Imager (TSI) is an observational technique through the use of images. In this study, we use cloud fields generated through Large Eddy Simulations (LES), then converted into imitation TSI videos using blender, to validate algorithms used on real would TSI cloud fields. Through a three way comparison, we can validate not only the TSI algorithm against a simulated truth, but also the LES simulations against the observations.

Spencer Tibbitts
Siena College
Title: Analysis of Homelessness Data in Dutchess County, NY
Session #: 2
Poster #: 127

According to The Housing Department of Urban Development (HUD), there were roughly 550,000 people without a home living in the United States in 2018. On any given night that same year, HUD reported that there were 91,897 people were homeless in New York State, meaning 1/6 homeless people in America reside in New York. CARES Inc. is a NPO in Upstate NY that's mission is to put an end to homelessness, and they have teamed up with myself and a few other students and faculty at Siena College to analyze their datasets. Using the last two years of data provided by Dutchess County, NY, we looked to highlight characteristics of those in greatest need of support in order to better allocate future funding. These characteristics include race & ethnicity, length of stay, age, exit destination, type of project they were a guest in, etc. While we have done much of the analysis for Dutchess County so far, we are looking to make this reproducible for all the counties CARES works with in eastern-NY.

Joseph Tibbs
University of Northern Iowa
Title: Remote Bias Electrostatic Force Microscopy: Seeing the Invisible
Session #: 1
Poster #: 87

Semiconductor device features are becoming ever more microscopic, and methods must be developed for detecting and characterizing defects in the chips before they are sent to consumers. Some promising methods for Back End Of Line (BEOL) testing involve scanning probe microscopes, which use micromachined tips for very high resolution topological measurement. However, by sensing electrostatic force at the microscale, these same probes can be used to detect things under the surface of the sample. In this project, we focused on how electric fields from buried metal lines can impact the motion of a voltage-biased tip. These techniques, referred to here as Remote Bias Electrostatic Force Microscopy (RB-EFM) still need to be characterized for their precision and accuracy, for example by determining the way in which tip geometry can impact results. By measuring tip response on standard samples, we compared the results with computational models and used them to develop theory which supports the experimental results.

Samantha Tietjen
Cleveland State University
Title: Optimization of Hydroxypropyl Cellulose (HPC) Microgel Imaging and Characterization Using Scanning Electron Microscopy (SEM)
Session #: 1
Poster #: 31

Microgels are polymer-based spherical nanoparticles suspended in water that exhibit a volume phase transition at a particular temperature. The standard, noninvasive method for characterizing microgels is with dynamic light scattering (DLS), which measures the collective diffusion of microgels exhibiting Brownian motion in a sample volume. While DLS provides reliable estimates for particle structure and dynamics, more direct methods of imaging are useful for studying polydisperse samples. Traditionally, scanning electron microscopy (SEM) uses an electron beam under high vacuum to characterize individual particles of dried samples. The dry particle imaging suffers from two main drawbacks in the case of microgels: the dehydrated particles shrink from their expected size by a factor of three, and dynamics are not observable due to particle immobilization. Ionic liquid was used to wet image microgels under high vacuum. Particles were suspended in a thin film of ionic liquid on a copper grid, and still images and movies were recorded to analyze the sample for both size distribution and dynamics. The average SEM sizes of the two samples tested generally agreed with the sizes obtained by DLS for the same particles both in ionic liquid and water at room temperature. Variation was observed in individual particle sizes, but the average SEM sizes for both samples were close to their DLS sizes. Initial attempts at diffusion analysis using SEM particle tracking yielded mixed results as it requires the tracing of many particles and thus further optimization.

Sydney Timmerman
Johns Hopkins University
Title: Entanglement Entropy in Two-Dimensional Yang-Mills
Session #: 2
Poster #: 48

Entanglement entropy is a measure of the degree of entanglement of quantum systems. The Bekenstein-Hawking formula for black-hole entropy resembles an entanglement entropy, suggesting that black-hole entropy may have a quantum origin. However, the symmetry in gauge theories, like gravity, presents an obstruction to calculating the entanglement entropy. In this work we use 2D Yang-Mills as a toy model of a gauge theory and calculate its entanglement entropy through Monte Carlo simulations of a dual fermion model. We find that the entanglement entropy naturally splits into two terms and is dominated by the "area" term coming from the boundary. We also find in three-independent ways that the "bulk" term scales linearly with the number of fields N, indicating that the large-N expansion of the logarithm of the Yang-Mills partition function has an O(N) term, in contradiction to the previous literature.

Hilario Torres Aponte
University of Puerto Rico Mayaguez Campus
Title: Thin Films of B-Phase VO2 For Electronic Applications
Session #: 2
Poster #: 126

Materials with metal-insulator-transition (MIT) have remarkable potential for utilization in device applications. Several vanadium oxides exhibit reversible MITs which can be initiated by heating, pressure, strain or light illumination, and are accompanied by substantial changes in electrical, mechanical and optical behavior. Vanadium dioxide is currently being probed from many different perspectives: ultrafast switching, memory devices, chromogenic materials, metamaterials, thermal infrared detectors (Bolometers) are some of the possibilities, which make these materials very attractive from the standpoint of direct commercial utilization of the related technology. In addition, some vanadium oxides exhibit a layered structure. This offers the additional possibility in which induced intercalation can be employed to develop novel micro and nanodevices for chemical sensing based on optical, electrical or mechanical interrogation. In this work. thin films of VO2 (B-phase) were grown by DC magnetron sputtering followed by detailed material characterization such as x-ray diffraction, atomic force microscopy and resistivity measurements

Amilcar Torres-Quijano
University of Texas - San Antonio
Title: Protoplanetary Discs and their Relationship to Exoplanets
Session #: 2
Poster #: 137

Exoplanets are known to exist around most stars. Their formation processes are now being characterized using state of the art ground and space-based telescopes. One such telescope that will advance research in the field is the future Thirty Meter Telescope (TMT) and its ability to utilize state of the art instrumentation (MICHI) for Thermal Infrared Spectroscopy (TIR). For example, MICHI will be a great tool for the identification of atomic, ionic, and molecular lines within protoplanetary disks. The use of data collected from instruments as those described above with simulation tools like FARGO3D will allow us to further understand which particular protoplanetary disk environments will yield specific planetary atmospheres. In this poster we we give a brief overview of the (TMT) telescope and (MICHI) instrumentation. Additionally, we highlight some recent observations and models that interpret the formation of exoplanets and their atmospheres.

Estephanie TorresVillanueva
University of Utah
Title: Measuring Stellar Cluster Ages and Mass Distributions using Stochastically Lighting Up Galaxies (SLUG) Methods for Local Group Galaxies
Session #: 2
Poster #: 80

We employ image classifications done by citizen scientists through the Zooniverse Local Group Cluster Search (LGCS) project to construct a more robust star cluster catalog based on Hubble Space Telescope (HST) data of the Andromeda (M31) & Triangulum (M33) Galaxies. With more than thousands of star clusters already detected from previous cluster search projects for both M31 and M33, we hope to expand catalogs for both galaxies by incorporating age and mass probability distribution functions and integrated light ages for all clusters. We are able to calculate the age and mass of our clusters from the measured photometry of potential cluster images in 6 passbands that range from near-UV to near-IR using the high spatial resolution of the Hubble Space Telescope's Wide Field Camera 3 (WFC3) and Advanced Camera for Surveys (ACS). To enhance our measurements, we account for (Av) extinction in our photometry by using a lognormal Av distribution with a mean of 1. We limit our cluster mass function (CMF) to mass breakpoints of 100 – 100000 M? in order to encompass a more general portion of the stellar population. We will also fit cataloged star clusters to the Kroupa initial mass function (IMF) & the Padova stellar track so as to maintain consistency with the previous LGCS done for the Andromeda Project. Through the use of these stellar models, created by the Stochastically Lighting Up Galaxies (SLUG) methods, we hope to enhance the completeness of the Local Group Cluster data for the Andromeda (M31) and Triangulum (M33) galaxies and other local group galaxies.

Lucas Tracy
Old Dominion University-Physics
Title: Electrons for Neutrinos: Lepton Energy Reconstruction
Session #: 1
Poster #: 136

A major area of research in nuclear/particle physics is the understanding of neutrino oscillations. The probability of measuring neutrinos to be in a particular state oscillates as they travel through space, and neutrino beam experiments are currently being run in an attempt to describe the nature of these oscillations. Neutrino beams cover a wide energy range, therefore a major obstacle for interpreting the results of these experiments is the determination of incident neutrino energy. By using electron data with a known beam energy from the CLAS detector at the Thomas Jefferson National Accelerator Facility, and exploiting the leptonic similarities between electrons and neutrinos, we tested various techniques for determining the energies of incident leptons. We found that for events with only one electron, one proton, and one pion we could accurately reconstruct the energy only for negative pions. We were also only successful if we used information from all three particles. We will present data from various targets at beam energies from 1 to 4 GeV.

Carlos Trevino De Leo
University of Texas - Brownsville
Title: Microfluidic Synthesis of Multiferroic Material BiFeO3
Session #: 2
Poster #: 124

Magnetoelectric materials can be described as having a hysteretic phenomenon where the polarization of the molecule changes when an electric field is applied, and analogously retains a magnetic field after an external magentic field has been applied. Multiferroic materials gained attention in the last 30 years because coupling the ferromagnetic and the ferroelectric states induces functionalities not present in either state by itself. Potential ground-breaking applications include the capability of creating a four to six-state memory element, hard drives with information written electrically (lower power input) and magnetically (non-destructive), electrical control of ferromagnetic properties, and the creation logic devices among others. Barriers with present production methods include the need of a high temperature (700ºK-1100ºK), high pressurization systems (~3.5-10GPa). Microfluidic synthesis used as an alternative method eliminates the grievance of the pressured system by a channel system made of Polyetheretherketone (PEEK) with a Young's modulus of 3.6 GPa; the material withstands the stress exerted in the process and high pH fluctuations. With microfluidic processing, controlling the volume passing through the media with high precision, providing a laminar flow and reaction isolation that ensures less size and shape randomization is possible. Typical reagents were used.

Martin Trouilloud
Brown University
Title: Electric Vehicle Charging Station Daily Load Analysis with a Randomized Algorithm
Session #: 2
Poster #: 133

The load on the power grid from electric vehicles is continuously increasing. Applying queueing theory and the Monte Carlo method, we built a randomized algorithm to investigate the power output of a highway electric vehicle charging station. Combining probabilistic (e.g. traffic rate) and deterministic (e.g. commuter patterns) data sources, this interactive simulation allows for more accurate analysis of the impact of electric vehicles on the grid.

Eleni Tsitinidi
Davidson College
Title: Mixture density networks as a machine learning technique for QCD analysis
Session #: 1
Poster #: 76

We map experimental high-energy scattering data to quantum probability distributions that characterize nucleon structure and the emergence of hadrons in terms of the quark and gluon degrees of freedom of QCD. We train a mixture density network (MDN) to address the inverse problem of transforming observable space into theoretical parameter space. The output of the network provides a mixture of Gaussians that is processed through a mode-finding algorithm to produce multiple points in parameter space with their probabilities. This approach has been used to accurately predict collinear parton distribution functions, and can be straightforwardly extended to other probability distributions, such as generalized parton distributions and Wigner functions. It will thus allow us to build a new generation of QCD analysis tools that will provide a new paradigm for the analysis of high-energy data and the design of future experiments.

Margaret Turcotte Seavey
University of Maine
Title: Clouds, Cameras, and Composition: Characterizing spectral differences between co-located Pandoras
Session #: 1
Poster #: 73

Pandora spectrometer instruments are built and calibrated the same way, however there is variability in total column nitrogen dioxide (NO_2) between co-located Pandoras. There are consistently co-located Pandoras at NASA Goddard Space Flight Center that provide ample datasets for analyzing subtleties between co-located Pandoras. The causes of spectral differences between co-located Pandoras should be characterized to quantify and reduce these differences. This characterization results in a better understanding of the Pandora instrument and how atmospheric and instrumental variability can impact retrieved nitrogen dioxide. There are a variety of factors that can contribute to spectral differences between co-located Pandoras. Clouds never appear in perfect shape and there are different cloud types that form at different altitudes. Instrumentation setup affects the retrieved total column nitrogen dioxide because the optional camera searches for the greatest light input and while the traditional non-camera Pandora instruments searches for the Sun using calculated sun position based on latitude and longitude. It has been observed that, in general, total column nitrogen dioxide observations by co-located Pandoras capture the same characteristics throughout the day but there are instances where the magnitude of delta between observations is different. We can reasonably say that nitrogen dioxide is heterogeneous by nature and through a combination of these factors leads to the delta being different between co-located Pandoras. Future work is needed to further quantify the impacts of the field calibration reference, cloud optical thickness, and hyperlocal NO_2heterogeneity on the correlation between co-located Pandoras.

Katherine Tyler
University of California, Merced
Title: Temperature Dependent Optical Spectroscopy of Perovskite Quantum Dots
Session #: 2
Poster #: 122

Perovskite quantum dots (PQD) have various applications in materials industry because of their tunable band structure and exceptional charge carrier dynamics. However, PQDs suffer from low stability and incomplete crystal phase transitions that hinders its device performance. In order to understand these drawbacks and address them we make use of low temperature photoluminescence (PL) spectroscopy techniques. We first systematically characterize PQDs using temperature dependent static and dynamic PL. We observe incomplete crystal phase transitions in PQDs ligated with OABr ligand, while those having the branched organic ligand APTES attached on the surface remain arrested in the high temperature cubic crystal phase. The partial crystal phase transition from tetragonal to orthorhombic phase below 140K reduces the charge carrier recombination lifetime and act as trap like sites resulting in lower performing devices at cryogenic temperatures. Our results indicate phase arresting of PQDs below 140K to be a result of surface modification techniques and opens up the possibility of high performance low temperature PQD devices.

Hilary Utaegbulam
University of Houston
Title: Constructing and Testing a Millimeter-Wave Fourier Transform Spectrometer
Session #: 1
Poster #: 95

Analysis of the Cosmic Microwave Background Radiation (CMB) is complicated by the presence of multiple sources of foreground signals emitted from the universe. In this experiment, a Fourier Transform Spectrometer was built and used to test the (initially unknown) microwave frequency of a monochromatic Gunn Diode. The Fourier Transform Spectrometer now serves as a valuable tool for frequency analysis as it can be used to test the transmittance and reflectiveness of broadband millimeter and microwave frequencies through various materials. This allows for the optimization of the detection of microwave frequencies from multiple sources in the observable universe by balloon-borne telescopes, such as SPIDER, so that efficient subtraction of foreground signals will be possible. The Fourier Transform Spectrometer is also useful for characterizing the spectra of the millimeter-wave sources used in SPIDER's calibration.

Martell Valencia
University of Texas Rio Grande Valley - East
Title: Work on Optical Counterparts to Gravitational Waves
Session #: 2
Poster #: 108

Gravitational waves are "waves" that ripple throughout space time as a result of violent and powerful events such as binary black hole mergers, binary neutron star merger, binary neutron star and black hole mergers. while LIGO has detected may gravitational wave events there have been few optical counterparts to them, in 2017 the first optical counterpart as a binary neutron star merger GW170817 event was detected and i have had the opportunity to study this data and look at the various properties of the merger alongside several other similar events gathered over the past year at the Christina Torres Memorial Observatory. i will be talking about my time analyzing this data and what results i gathered so far.

Christina Valletta
University of California, Merced
Title: The Development of a Quantum-Optical Apparatus used in the Evaluation of Photon Statistics
Session #: 1
Poster #: 99

One of the most interesting and principle pieces to quantum optics is photon statistics; more descriptively, the optical setup used to measure photon statistics. In this experiment, an optical setup for observing the second order correlation coefficient, otherwise known as the intensity coefficient, was developed. The intensity coefficient is used to determine if a light source is bunching, coherent or anti-bunching; this coefficient can determine what type of source light the photons are being produced by. Here, the second order coefficient was calculated from a Hanbury-Brown Twiss interferometer with an inferred laser source. Near the end of our optical setup, the photons entered two dark boxes where their presence was recorded with photon counters. By recording the photons counts over a time scale of half a millisecond concurrently for both dark boxes, the second order coefficient will be able to be calculated. With a coefficient of near one, it will be shown that the laser used in this experiment produces coherent light leading the way for other quantum optic experiments.

Tamas Vami
Johns Hopkins University
Title: Search for Supersymmetry using Razor variables at the LHC’s CMS experiment
Session #: 2
Poster #: 94

In this poster, a search for Physics beyond the Standard Model using the CMS detector at CERN will be presented. Searches for production of supersymmetric partners of gluons and quarks at the LHC have excluded these particles for masses up to the TeV scale. The poster will present results and show the analysis techniques in these searches, with an emphasis on the use of razor variables for the discrimination between standard model backgrounds and signal.

Vivek Vankayalapati
University of Utah
Title: The AstronomUrs: A High Impact Astronomy Outreach Program
Session #: 2
Poster #: 68

The AstronomUrs is an outreach group, run from the South Physics Observatory at the University of Utah, which conducts extensive outreach activities of wide and far-reaching scope, from physics demonstrations, star parties, K-12 presentations, astronomy festivals, and much more. We also host weekly star parties at the observatory, open to the public. Our outreach team is composed of a permanent staff member and several student employees paid as teaching assistants. Our operations utilize 7 rooftop and 13 portable telescopes in addition to over 25 physics and astronomy demos and numerous educational presentations. The program also travels extensively across the state and beyond, allowing our activities to be accessible to rural and tribal areas. The program grew out of a lack of accessible astronomy education/outreach resources in Utah and has since become the largest astronomy outreach program in the state. In the past year alone, we hosted 171 events reaching approximately 26,000 people. Our audience is also broad, including, but not limited to, K-12 schools, state and national parks, community groups, amateur astronomers, university organizations, and dark-sky advocacy groups. Our program operations are funded primarily through donations and indicates our community support and recognition.

Joseph Vazquez
Randolph College
Title: Analyzing Alvin Lucier’s "I Am Sitting In a Room" as a Potential Measure of Room Modes
Session #: 2
Poster #: 27

Alvin Lucier's "I am Sitting in a Room" (IASIAR) is an experimental music composition in which a sound in a room is recorded and its recording is played back until, according to Lucier, the resonant frequencies of that room are amplified. We collected data using a modified version of Lucier's method for various sounds, including the monologue written in his score, performances in singing and flute, and pink noise. We used SciPy, MatPlotLib, and MATLAB to process the data from our resulting sound files. We seek a method to quantify our data as well as to develop a theoretical model to better understand the underlying mechanisms regarding Lucier's method. This project was funded by the 2019 Randolph College Summer Research Program.

David Vestal
High Point University
Title: Fraction of Hot Subdwarf Binaries in the Southern Hemisphere
Session #: 2
Poster #: 57

Hot subdwarf stars are theorized to exist in binary systems. To determine the fraction of hot subdwarf stars in binary, we observed the behavior of thirteen stars at three different time points to detect changes in radial velocity. These stars were selected from Geier's Gaia DR2 list of 40,000 potential hot subdwarfs. Four of the stars in our survey showed large changes in radial velocity (above 40 km/s), indicating they are likely in a binary system.

Gabriela Vidad
Adelphi University
Title: Development of a Simple Numerical Model to Test Braess' Paradox and Traffic Flow
Session #: 1
Poster #: 71

We developed a simple model to explore the application of Braess' Paradox in a computational environment. Braess's Paradox is the proposed explanation for increased travel time when adding a road to a network, rather than the expected result of decreased travel time. The goal of our research was to develop a model with the ability to mimic various road networks and manipulate conditions, such as the number of cars, speed limits, and available paths, in order to analyze the best configuration of intersections and roads that will lower the effects caused by the application of Braess' Paradox. We have been able to create an algorithm that mimics two paths with an intersection, and cars that have the ability to switch between the two paths. By further analyzing Braess's paradox, we may closely analyze real road networks and find network configurations that would best decrease travel time and carbon emissions, without having to deeply further development in alternative transportation methods.

Rebecca Voss
Henderson State University
Title: GPS Locator for High Powered Rocketry
Session #: 2
Poster #: 13

High Power rocketry is a hobby that is growing in popularity among students and educators across the nation. However, with visibility of an object that travels 5,000 feet in a matter of seconds is poor and rockets often land more than a mile from the launch site. This project uses Arduino products to manufacture a GPS locator that is compatible with a laptop computer so that may be brought into the field at the launch site.

Georgia Votta
Augustana College
Title: Characterizing a Charged Particle Detector Telescope
Session #: 1
Poster #: 146

Performing experiments on neutron-unbound nuclei requires the detection of a neutron, a charged particle, and in some instances, gamma rays. The development of a charged particle detector telescope will facilitate the detection of these particles for future experiments performed at the National Superconducting Cyclotron Laboratory at Michigan State University. This system will allow charged particle detection along with efficient detection of gamma-rays by a device like the CAESium-iodide scintillator ARray (CAESAR) and neutrons with the Modular Neutron Array (MoNA). In order to construct this system, each charged particle detector (Si-PIN, position sensitive Si, or CsI(Tl)) needs to be tested to ensure each detector's response along its area is uniform and to verify the manufacturers' specifications. The construction of a raster scanner facilitates the process of the position-dependent testing inside a grounded metal box. The raster scanner consists of two stepper motors controlled by Arduino software that allow a 210Po source to be reproducibly transported across the surface of each detector and a mask that collimates the direction of the alpha particles. Results of detector characterizations will be presented.

Sarah Vue
Henderson State University
Title: Henderson Science Olympics 2019
Session #: 2
Poster #: 5

Henderson State University's Society of Physics Students in collaboration with Biology Club, Chemistry Club, Robotics Club, and American Society of Engineering Educators hosted Science Olympics, a competition for local high school students to promote interest in different science disciplines. Arkansas is largely rural, and many schools do not generally have funding to participate in engaging science events. Due to generous sponsorships from Suddenlink, Henderson Student Activities Board, and the SPS National Office through a Marsh White Award, there were no expenses to the students or teams to participate. 116 students from 8 schools across Arkansas participated in the event and received lunch and t-shirts for free. Students could compete in up to 5 out of the 7 possible events, which included Biology Bone Challenge, Biology Neuronal Synapse, Chemistry Physical Separations, Chemistry Quantitative Analysis, Physics Mouse-trap Car, Engineering On-the-spot Build of a Thermal Shield, and Robotics Turret Build with a Sparkfun Kit.

The HSU SPS chapter organized and ran the logistics of the event. A ceremony was held after the competition for the students to receive their awards. The details of the event are presented here.

Morgan Waddy
University Of Virginia
Title: Looking Deeper into Mildly-Recycled Binary Pulsar J1516-43
Session #: 1
Poster #: 26

PSR J1516-43 was found in the GMRT High Resolution Southern Sky Survey for pulsars and transients. The pulsar has a period of 36 ms and is in an orbit of 228 days with a companion of mass ~0.42-1.29 Msun which implies the companion to be either a white dwarf or a law-mass neutron star. I will outline the four year history of observing this pulsar, the interesting characteristics of the pulse profile, and some complications in the recent data.

Tobin Wainer
University of Utah
Title: Search for Local Group Clusters: M33 Survey Data
Session #: 2
Poster #: 46

We construct a catalog of star clusters in the Triangulum Galaxy (M33). The catalog is the result of the Local Group Cluster Search (LGCS) citizen science project through Zooniverse, where users classify images from the Hubble Space Telescope (HST). We base our star cluster catalog on the fraction of the 60 users that viewed each image that identified each object as a star cluster. Preliminary results show more than 1800 star clusters. We derive the completeness of the catalog from analyzing 1700 synthetic clusters to determine detection limits, as well as comparing our results to previous catalogs in the literature. By weighting Zooniverse users based on how many objects they classified as star clusters that were in fact star clusters, we hope to improve the completeness of the catalog. The catalog expands upon previous ground based catalogs extending the catalog by approximately 1300 clusters, providing base data for further research into star formation in M33.

Jeremiah Wald
Missouri Southern State University
Title: The Physics of the Triple Jump and the Long Jump
Session #: 1
Poster #: 50

We investigate the physics of takeoff and landing for the triple jump and the long jump, presenting both theoretical and experimental findings. By first looking at the student athlete performing the long jump as a single projectile we are able to compare the jump takeoff angle to their performance. We extend this analysis of the long jump to the triple jump by comparing the similarities and differences between the two events. We determine the best possible takeoff angle for each phase of the triple jump in order to obtain maximum horizontal range. At these best possible angles, the forces applied during takeoff and landing are measured using a force plate sensor at each phase of the jump. We also compare the techniques of: the athlete jumping as high as possible for each jump in the triple jump or maintaining a constant horizontal velocity during the triple jump. Results from college level track athletes are analyzed in order to determine the best possible performance for each athlete.

Joseph Wananda
University of Wisconsin - River Falls
Title: Nonsystematic Error Investigation in Time of Flight Cameras
Session #: 2
Poster #: 86

Depth images in time of flight cameras are affected differently in terms of image resolution by various environmental factors. This makes it very difficult for a single error reduction method to work on reducing all nonsystematic errors with the use of a continuous wave time of flight camera, we investigate the sources of various environmental factors present in the scene of a depth image and the extent to which they affect the accuracy of the depth data provided by the time of flight camera.

Jing Wang
University of San Diego
Title: Probing the fluid-fluid interfacial dynamics of phase-separated colloid-polymer mixtures
Session #: 1
Poster #: 143

Interfaces between two fluids are ubiquitous in nature and have long attracted scientific attention. We study the thermally induced capillary waves between two colloidal fluids (a colloid-poor, or “gas” phase, and a colloid-rich, or “liquid” phase) formed through the liquid-liquid phase separation (LLPS) of a colloid-polymer mixture. Using suspensions of ~200 nm colloidal particles and polymers we observe the mixture phase separates into two fluid phases with ultralow surface tension. We are therefore able to optically detect and quantify the roughness of the interface using a novel extension of differential dynamic microscopy (DDM). Here we also investigate the LLPS process in shear flow using bright-field and light-sheet microscopy. We measure the size and shape of elongated liquid domains that have been deformed due to shear. Finally, using the temperature-responsive feature of our colloidal particles we study the kinetics of phase separation under shear flow. We hope our study of LLPS process in shear flow can provide fundamental insights into hydrodynamics and thermodynamics and provide novel strategies for structuring soft materials.

Toler Webb
Davidson College
Title: Modeling the Double Well Potential in Quantum Mechanics
Session #: 2
Poster #: 40

The double well potential in quantum mechanics is modeled through the use of the spectral method with an infinite square well basis. Computational methods are implemented to find appropriate Hamiltonian matrix sizes to avoid unnecessary calculation time, and Wigner functions are generated as analogs to classical phase space.

Jason Williams
Texas Lutheran University
Title: Fabrication and Characterization of Porous Silicon Thin Films
Session #: 1
Poster #: 82

Porous Silicon (p-Si) refers to a thin film matrix structure of nanoscale crystalline Si, typically formed atop a bulk single crystal Si substrate. The p-Si structure has been fabricated on a wide range of Si substrates and is interesting because the porous silicon thin films exhibit optical emissions not possible in ordinary crystalline silicon. At TLU, we have fabricated a series of porous silicon thin films on p-type and n-type crystalline silicon substrates using an anodic etching cell technique. Wafers are prepared with a chemical cleaning process and then submerged in hydrofluoric acid and subjected to an electric field. Process time and current density were varied to examine the effect on the resulting optical emission, we can influence the resulting optical properties. Raman spectroscopy was used to ascertain the resulting crystalline structure of the material, and photoluminescence was measured from each of the prepared samples.

Devon Williams
Johns Hopkins University
Title: Protecting Quantum Algorithms on Noisy Quantum Computers
Session #: 2
Poster #: 58

Current Noisy Intermediate-Scale Quantum (NISQ) computers suffer from large amounts of noise, limiting the duration by which algorithms can run. Current methods exist that can be used to reduce this noise, however it has yet to be shown whether or not these methods (largely reliant upon Dynamical Decoupling (DD)) are the best way to go about doing this. We propose methods to go about avoiding the noise all together using Decoherence-Free Subspaces (DFS's) in such a way to run computations in an encoded space blind to environmental noise.

Turner Woody
Johns Hopkins University
Title: Searching for R-Process Enhanced Metal Poor Stars in the RAVE Survey
Session #: 2
Poster #: 65

Very Metal Poor stars, [Fe/H] < -2.0, are old and have been contaminated by only a few enrichment events like supernovae and neutron star mergers. To better understand the nucleosynthesis of heavy elements at these sites, specifically that of rapid neutron-capture (r-process) elements, a large catalogue of r-process enriched stars is needed. To contribute to this growing catalogue we used the Apache Point 3.5m telescope to obtain high resolution (R~31500) spectra across the whole visible band for 30 northern hemisphere candidate metal poor halo FGK giants, identified from the RAdial Velocity Experiment (RAVE) survey. Candidates were previously identified using a t-distributed stochastic neighbor embedding (t-SNE) algorithm that classified stars based on the similarity of their RAVE spectra. We calculated stellar parameters using excitation-ionization balancing between FeI and FeII lines, and measured elemental abundances for several light (C,N,O), alpha (Mg,Si,Ca,Ti), iron peak (Fe,Cr,Mn,Co,Ni,Zn), and neutron capture (Rb,Sr,Y,Zr,Ba,La,Ce,Pr,Nd,Sm,Eu) elements. Our sample had a metallicity range of -3.1 < [Fe/H] < -1.58, and exhibited effective temperatures and surface gravities characteristic of giants, confirming the effectiveness of the t-SNE identification. Our sample also contains 9 stars exhibiting r-process enhancement, with 3 being strongly enriched (r-II) stars, indicated by an excess of europium [Eu/Fe] > +1.0. We acknowledge support from the UT Austin REU grant AST-1757983 (PI: Jogee) funded by the NSF REU and DOD ASSURE programs.

Gaoyong Wu
University of Northern Iowa
Title: Identifying Elemental Composition of Sand Grain with EDX
Session #: 1
Poster #: 128

Energy Dispersive X-ray Spectroscopy (EDX) has been used in analyzing the elemental composition of different objects in many fields. In this project, sand grains are to be scanned and analyzed. Sample sands were collected from multiple spots in the Killpecker Dunes in Wyoming. For the efficiency of scanning, sand grains were screened and separated by different size. Sorted sand grains were glued into plates, and the surface needed to be scanned has been polished. To prevent electrical charging issue in the chamber of Scanning Electron Microscope (SEM), plates' surface was also coated with a thin layer of gold. Since each atom has its characteristic emission spectrum which can be used to identify themselves. This property is used in EDX analyzing. By applying primary electron beam, the sample atoms will be excited, and then, emit x-rays which will be collected by a detector. In the meantime, element maps and secondary electron (SE) image are generated. Traditional way of examining sand grains is bulk analysis. Generally, sand grains were melted into glass and the average elemental composition of sands would be analyzed. To enhance the elemental composition data, the advantages of SEM and EDX technique are applied to display detailed structure and composition of every individual sand grains.

Katherine Xiang
Johns Hopkins University
Title: Effects of Substrate Stiffness on the Distribution of 3T3 Cell Force Fluctuations
Session #: 2
Poster #: 36

The movement of animal cells is controlled by a collection of actin filaments pulled on by myosin motors within the cytoskeleton. Actin, myosin, and cross-linking proteins are well-studied at the molecular level. However, the link between actin-myosin machinery and the structure of the cytoskeleton is not well understood. We present results from micromechanical measurements of 3T3 fibroblasts on flexible micropost arrays, to better understand how continuous motions by actin filaments and myosin motors can generate large-scale shape fluctuations in a cell, and lead to complex phenomena such as chemotaxis and tissue morphogenesis. Overall, our results demonstrate that the distribution of cell force fluctuations is non-Gaussian: the cell cortex generates forces intermittently, with steps that display earthquake or avalanche-like behavior. The cells' non-Gaussian force fluctuations resemble those of a jammed material or a sandpile, demonstrating criticality in the cellular force generation process. We find that these avalanches are qualitatively the same across substrates of different stiffnesses.

Danqi Yin
Coe College
Title: COMSOL Modeling of Laser Modification of Lead Vanadate Glasses
Session #: 1
Poster #: 64

The modification of lead vanadate glasses induced by 785-nm laser thermal heating has been modeled using COMSOL finite element modeling. The model has taken into account several complex changes, including the formation of crystalline phases, melting, and vaporization. In order to fully understand and model the mechanisms behind this phenomenon, the research included the measurement of parameters needed for the accurate calculations carried out by the COMSOL software. These include thermal parameters like the glass transition, crystallization, and melting points; specific heats for various phases; enthalpy of crystallization; optical absorption; accurate laser spot sizes; and others. A large number of experimental modifications were also carried out at different spot sizes and laser powers, creating a database of modified sites to compare with the COMSOL results. The model accurately reproduced the geometry we encountered experimentally, though work is ongoing to ensure that the model can also explain the variety of measured results. Work supported by Coe College and by the United States National Science Foundation under grant numbers DMR 1407404 and DMR-1746230.

Amy Zingsheim
University of Wisconsin - River Falls
Title: Investigation of the Active Base for use in the mDOM in the IceCube Upgrade
Session #: 2
Poster #: 19

In an effort to characterize the behavior of the active base designed for use in the mDOM for the Icecube Upgrade, a V2.0 active base is used to gather PMT data, which is then analyzed. A repetitive sinusoidal signal was found in the noise of multiple waveforms with a frequency around 10 MHz. The transit time distribution for signals measured with the active base appears to be the same as the transit time distribution for signals measured with a passive base. Average waveforms from measurements with the active and passive bases are also very similar. Analysis of the charge distribution with the active base proved hard to complete since distinguishing between noisy and clean waveforms was not reliably achieved.