2018 NSBP POSTERS

Monday, November 5

ASTRO, COSMOLOGY & EARTH SCIENCES POSTERS SESSION:

#1 – 1.) Isiah Holt, The Pennsylvania State University
The Kinematics and Magnetic Field of Jets in Narrow-Line Seyfert I galaxieS

We still do not know why certain galaxies launch powerful jets of relativistic plasma. The basic requirements appear to be the presence of a supermassive black hole, and a surrounding accretion disk. Narrow-line Seyfert I galaxies (NLSY1) lie at the low end of the central black hole mass range, yet they can still launch jets. They are also accreting mass at high rates which is useful for understanding how the jets are launched. We are studying the proper motion and polarization of jets launched by narrow-line Seyfert I galaxies. These two properties reveal the kinematic flow properties and magnetic field structure. Using the Very Long Baseline Array (VLBA) we can make images of the Seyfert Is at multiple radio frequencies, with a highest resolution of 0.05 milliarcsecond, at different epochs, and create a time-lapse to measure the speed of the jet over time. We also look at the polarization in the jets throughout the time-lapse. We should expect to have images of at least three NYSL1s and an estimate of the jet speed for these active galactic nuclei. For the future we are to generate spectral index maps and measure the shift of the apparent jet core position as a function of frequency. Towards the end of producing the maps, we can make estimates of the magnetic field strength in the jet plasma.

#2 – 2.) Angela Twum, Pomona College
"Galaxy Mergers On FIRE: Stellar Shell Evolution in Post-Mergers"

Shells are low surface brightness regions that appear as concentric arcs of dense stellar particles within the stellar halo of massive galaxies. Shells form as a result of galaxy mergers and can be an indicator of how recently the merger took place. To study how the structure and mass distribution within these shell structures evolve, we utilize a suite of 24 high resolution galaxy merger simulations. In this work, we focus primarily on a representative fiducial run of the merger suite. We visually identify a number of shell structures in both configuration and phase space, and then trace the distribution of star particles forward and backward in time to observe how these shell structures evolve. In addition, we test the feasibility of our analyses as a method that can be used by observers to identify and study the brightness evolution of shells in the local universe.

#3 – 3.) David Zegeye, Haverford College
Probing Additional Gravitational Lensing Effects of Supernova iPTF16geu

Gravitational lensing is an effect of General Relativity, where massive objects, such as galaxies, are able to bend the light path of background sources, making the position of the observed image differ from where the source would be seen in the absence of lensing. If the lens is massive enough, it can produce multiple images of the source, each with a different magnification. However, there may be discrepancies in the predicted and observed magnifications of the images. This difference can be resolved by accounting for additional microlensing due to stars in the lensing galaxy. Supernova iPTF16geu, discovered in 2016 by the Intermediate Palomar Transient Factory (iPTF), is a lensed source that still has a discrepancy between the predicted and observed image magnifications, even after accounting for microlensing due to stars. We present a more detailed gravitational lensing model that attempts to account for the discrepancy observed in the magnifications of iPTF16geu. We find that our more realistic model is an improvement from simpler lensing models, with still the possibility of ongoing millilensing caused by additional objects, such as dark matter substructures, in the lensing galaxy.

#4 – 4.) Marika Edwards, University of Wisconsin, Milwaukee

"Developing a Gravitational Microlensing Generator to Determine Efficiency in Detecting Gravitational Effects of Primordial Black Holes in the Milky Way Dark Matter Halo"

Massive Primordial Black Holes (MPBH) could constitute the majority of the dark matter, anidea revived by the LIGO observations of merging 30 solar mass black holes. In this model, the mass distribution of MPBH ranges from 0.01 to 100 solar masses, peaking perhaps at 50 solar masses. This project uses the Dark Energy Survey data to perform a microlensing measurement of massive compact objects at 10-100 solar masses. Microlensing occurs when MPBH passes in front of a background star, briefly brightening the output from that star. The key idea is that a microlensing event has a duration of roughly t = 2.5 years and thus masses in the range expected for MPBH are observable in the DES. We seek to constrain the number of events that are expected within the halo by determining the efficiency of our detector, the number of stars monitored during the timescale of the survey, and the probability of lensing events occurring in nature. In this project, we created mock light curve events for stars in the Dark Energy Survey (DES). After constraining the Survey data to stars, we utilized star characteristics and calculated relative error. By using these data, as well as varying the unknown parameters of the MPBHs, we create approximately 50,000 light curves per sampled star. These resulting microlensing event light curves support in determining the efficiency of the current fitting algorithm, as well as any future algorithms. Our project will directly support the creation of efficiency maps which will help determine the number of actual events to expect within the DES.

#5 – 5.) Zaphanlene Kaffey, DePaul University

"Hierarchical Structure Formation Using Quasars and Lyman-Alpha Forests"

In this study, we seek to understand the evolution of Large Scale Structures as a function of redshift using Sloan Digital Sky Survey (SDSS) Lyman-alpha Forest data. While the SDSS has supplied a rich set of cosmic data, we focus on quasars. The quasars we observed are billions of light years away. As light traverses these large distances, it interacts with Large Scale Structures (i.e. clustering of matter in the universe at scales larger than galaxies). The specific Large Scale Structures we examine are hydrogen clouds. Since these clouds are in between us and quasars, the light emitted by quasars must interact with hydrogen clouds before it reaches us. These interactions are detected in spectral analysis as absorption lines called Lyman-alpha lines, with a group of Lyman-alpha lines being a Lyman-alpha Forest. By examining Lyman-alpha Forests, we can trace the evolution of Large Scale Structures over time. When we discuss this evolution, we are referring to the way hydrogen clouds fragment, i.e. their "hierarchical structure". With our project, we measure hierarchical structure formation using mathematical functions called "wavelets". These are functions that are especially adept at analyzing data at various scales. We generated a code that computes these wavelets, and from this wavelet analysis we hope to deduce hierarchical structure formation, thus mapping sectors of the universe and how they have changed over time, all the while crafting a deeper understanding of the formation of the universe as a whole.

#6 – 6.) *Andrew Baker (Rutgers University)
"LADUMA: Looking At the Distant Universe with the MeerKAT Array"

Understanding the formation and evolution of galaxies requires that we understand the cosmic evolution of their gas content, including their neutral atomic hydrogen (HI) reservoirs. The forthcoming LADUMA (Looking At the Distant Universe with the MeerKAT Array) survey will use over 3000 hours of observations with South Africa's new "MeerKAT" array of radio telescopes to study galaxies' HI emission out to a redshift z = 1.4, when the universe was only a third of its present age. I will discuss some of LADUMA's scientific objectives and technical challenges, highlighting how multiwavelength observations of the survey's target field (e.g., optical spectroscopy to enable spectral line "stacking" and distinguish OH megamaser interlopers from true HI detections) will play an important role in its success.

#7 – 7.) *Arthur Kosowsky (University of Pittsburgh)
"The Simons Observatory: Next Generation Microwave Background Observations"

#8 – 8.) Pradi Kattel (Howard University)
"Quantum Tunneling in black holes"

In classical General Theory of Relativity, black holes are cold objects. Everything that falls into black holes remains inside forever and nothing can come out. Thus, black holes cannot be in equilibrium with the surrounding. However, this picture completely changed when Hawking used quantum field theory in curved space-time to show that even stationary black hole must radiate with a thermal spectrum. Even when this discovery is far from contributing to any physical applications and lacking importance in any astrophysical phenomenon, it has far-reaching effects in theoretical physics. It showed a possible deep connection between gravitation, quantum mechanics and thermodynamics. It raised some of the toughest paradoxes like Firewall and Information loss paradox – people are still struggling to resolve the information paradox, one of the longest unresolved paradoxes in modern physics. Hawking radiation will be described as the quantum mechanical tunneling of virtual particles in the vicinity of the black hole. If a pair of positive energy and negative energy is produced inside a black hole, the tunneling probability of positive energy particle will exactly give the thermal Boltzman factor with correct temperature and the negative energy particle decreases the mass of the black hole. This quasi-classical picture of Hawking radiation is the clearest and physically more meaningful picture of the radiation.

#9 – 9.) Janelle Holmes (University of Michigan)
"Assessment of Capabilities of L1 Monitors using Dst Index"

Real-time solar wind measurements from L1 monitors allow space weather forecasters to make predictions between 15 minutes and an hour in advance. These warnings can be crucial in preserving the health and safety of astronauts and airplane passengers near the poles, and in preparing for events that affect satellites and electrical grids. Geomagnetic indices such as Disturbance Storm Time index (Dst) allow for a concise, standardized prediction and measurement system. For years, the Space Weather Prediction Center used ACE real-time solar wind data to develop its one-hour Dst forecasts, but has recently switched to primarily using DSCOVR data as its source. In this study, the performance of both orbiters in predicting Dst was assessed in an attempt to determine whether or not switching to DSCOVR data has resulted in improved forecasts. This assessment was performed by comparing Dst output from the satellites to Dst derived from ground-based magnetometers. The periods of study were chosen to encompass times when the satellites were close to each other, and when moderate to high activity was observed. Dst predictions were made using the Space Weather Modeling Framework, specifically using BATS-R-US, Ridley Ionosphere, and the Rice Convection Model.

#10 – 10.) Kaylin Reese (North Carolina A&T State University)
"Biomass burning aerosols optical properties–impact on climate air quality and health"

Biomass burning (BB) aerosols can substantially degrade air quality near their sources, but these pollutants are also subject to long range transport. BB aerosols continue to deserve attention from the scientific community because many aspects of their impact on air quality, cloud formation, human health, and climate remain poorly quantified. Biomass burning generates hundreds of incomplete combustion products in the form of gases and aerosols. The burning of biomass fuels is a global health disparity issue. Our work focuses on understanding the optical properties of BB aerosols that includes measuring their absorption, and scattering cross sections. Additional Comments: We acknowledge the support by a grant from the National Science Foundation NSF-# 1600415

#11 – 11.) Jordan Green (Pomona College)
"Mapping Gas and Stellar Distributions in Galaxy Merger Simulations"

We attempt to make mock observations of the effects that galaxy encounters have on the distribution of stars in galaxies. For this project we will employ the FIRE ('Feedback In Realistic Environments') model (Hopkins et al. 2017). This novel model is capable of resolving the multiphase nature of the interstellar medium. Our suite of simulations consists of 27 high resolution runs, consisting of combinations of three eccentricities, three impact parameters and three spin-orbit orientations (prograde, retrograde and perpendicular). Our choices are consistent with cosmological observations and large surveys. We also use Python 2.7 to extract and optimize data from the mergers. Using the suite of galaxy merger simulations already on disk, we look at where the locations of the stars and gas are concentrated within galaxies. Within the disk itself We also look at how merging affects disk thickening and the stellar halo. In addition to spatial information, we also investigate stellar segregation in terms of age and metallicity. Using the gaseous component of the galaxies, we try to build a pipeline to calculate their angular momentums. The goal here is to project and rotate the galaxies through multiple perspectives, from face on to edge on. This allows us to find the appropriate angle of which to view any component of the merger. Ultimately, these maps will guide us to gain a global understanding of stellar migration as the stellar component is built through mergers.

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AMO/POP POSTER SESSIONS:

#13 – 1.) Chares Brown (Yale University)
"Magnetic Levitation of Superfluid Helium: Towards Quantum Optomechanics with Liquid Drops"

The field of optomechanics studies the interactions of light with the vibrational motion of an object contained within an optical resonator, providing an avenue to study the quantum behavior of macroscopic objects. Because the observation of quantum behavior suffers from heat exchange with the environment, we have developed a system to minimize heat exchange– a mm-scale, magnetically-levitated superfluid liquid Helium (SLHe) drop in vacuum. SLHe is a promising material in which to access new regimes of quantum optomechanics, due to its extremely low optical and mechanical dissipation, its high thermal conductivity, its ability cool itself via evaporation, and its unconventional degrees of freedom (such as surface waves and quantized vortices). Magnetic levitation is expected to remove an important source of environmental heat exchange by allowing the optomechanical system's mechanical energy and optical energy to be stored entirely within the SHLe drop. We will describe the stable levitation and thermal characteristics of isolated SLHe drops in vacuum.

#14 – 2.) Klauss Dimitri (Georgia Institute of Technology)
"Realizing a Better Magneto-Optical Trap by Building a Laser Locking Circuit"

Research on the physics of strongly correlated electron systems has gained increased momentum and interests have begun to focus on tools that can further explore these fascinating systems. Quantum-degenerate bosons are known to have potential uses as the building blocks for developing such tools and the cooling and trapping of these atoms with lasers has emerged as a good way to study strongly correlated electron systems. Thus, here we plan to cool down atoms using the effects of Doppler cooling. The goal of this project is to create a circuit that can successfully lock the laser that will be used to Doppler cool cesium atoms, allowing us to produce a better Magneto-Optical Trap (MOT) and become more efficient in creating cold atoms. The boson nature of cesium allows this project to be a good resource for future attempts at realizing a Bose-Einstein Condensate (BEC).

#15 – 3.) Erin Strickland (Howard University)
"Graphene-based Metasurfaces for Multimode Tunable Terahertz Modulators"

Metamaterials are artificial structures with engineered electromagnetic properties derived from the arrangement of metallic unit cells (or meta-atoms). The feature size of the unit cell is directly proportional to the wavelength of interest. Therefore, large gains in research and development of metamaterials have been made in longer wavelengths due to well-established microfabrication techniques. Graphene metastructures have several advantages over traditional metallic structures including, but not limited to high carrier mobility, flexibility and tunability through application of a gate voltage or external field. Therefore, the objective of this research is to fabricate the theoretically proposed tunable graphene metamaterial terahertz (THz) devices with high amplitude modulation (up to ~80%) and tunability (up to 400 GHz). The active surface of the fabricated devices is 2.5 x 2.5 mm2 and measurements to monitor the ability to modulate THz waves were made using a high resolution terahertz time-domain spectrometer. We aim to integrate these devices into systems for sensing and quantum electronics applications. This work is supported by the Air Force HBCU/MI Program, NSF Center for Integrated Quantum Materials (DMR 1231319) and the Harvard Center for Nanoscale Systems NNCI Scholars Program.

#16 – 4.) Ashley Blackwell (Howard University)
"Reconfigurable graphene-based dual-band rectenna for terahertz energy harvesting"

In recent years, there has been an increasing demand for more efficient energy harvesting solutions than the presently available ones. The concept of rectenna (RECTifying antENNA) devices dates back to the early 1960's with the pioneering work of William C. Brown. Initially proposed for wireless power transmission, it has become an alternative and very efficient way of harvesting electromagnetic radiation and converting it into a direct current. A standard rectenna incorporates an antenna connected with a rectifier (formed by one or more diodes) to convert high-frequency electromagnetic fields to direct current power. Fundamentally, the rectenna and the solar cell are similar in that both require the absorption of photons to generate a direct current. The main problem in such a device is the impedance mismatch between antenna and diode, which limits the total amount of power received by the antenna and delivered to the diode for rectification. Due to technological constraints, harvesting techniques are more challenging at terahertz and infrared frequencies because of (i) the strongly dispersive behavior of metals, (ii) the lack of rectifying diodes with good high frequency direct current conversion efficiency and (iii) the antenna diode impedance mismatch. To date, no efficient terahertz energy harvester is available to overcome the gap between RF harvesting technology and solar panels.We propose a tunable dual-band graphene-based dipole antenna on silicon substrate for potential use as an electromagnetic energy harvester in the terahertz frequency regime.

#17 – 5.) Katheryn Kornegay (Pomona College)
"Using Thermoreflectance Imaging to Characterize Organic Photovoltaic Defects"

Polymer-based organic photovoltaic devices (OPVs) are attractive because of their flexibility, tunable material properties, and potentially low cost [1]. However, non-uniformities and defects can decrease the operating efficiency. We demonstrate the use of high spatially resolved thermoreflectance imaging to examine electrical shunts and other defects in PCBM-based devices. Under electrical bias, we observe both strong localized thermoreflectance signals that correlate with visible defects in the cells and also a weaker, more uniform thermoreflectance signal across the entire cell. We expect this whole-cell thermoreflectance signal to be a measure of the heating of the whole cell, while the localized strong signals originate from electrical shunting at defects in the cell. Our current work focuses on exploring the physical origin of the observed Ultimately, the goal of this project is to combine examining the thermal signature of defects in response to sweeping the cell bias conditions, together with more conventional means of characterization, such as current-voltage and Laser Beam Induced Current measurements, to develop a powerful suite of tools for characterizing the types and physical origin of defects present in OPVs. signals. To test if the thermoreflectance signal arises from heating, we will use a thermoelectric cooler to modulate the temperature of the unbiased cell while measuring the resulting thermoreflectance signal. We will also compare our initial results obtained by imaging the light-absorbing side of a cell to imaging of the back-side silver contact. [1] Gang Li, Rui Zhu, and Yang Yang, "Polymer Solar Cells," Nature Photonics, vol. 6, March 2012, p.153.

#18 – 6.) Chan Kyaw (Howard University)
"Fano Resonances in Terahertz Metameterials"

Certain asymmetric THz structures show Fano resonances in addition to dipole and LC resonances. In this experiment, square metamaterial structures with four gaps are fabricated and reflection measurements are extracted. Asymmetry is introduced by controlling the top gap distance. The strength of Fano resonances show a strong dependence on top gap distance. Resonances with respect to different polarization angles are also investigated. The resonances show a dependence on polarization angles for a large asymmetry produced by 72.5 um top gap distance. Simulation results also match with experimental data.

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CHEMICAL, BIOLOGICAL & MEDICAL PHYSICS POSTER SESSIONS:

#20 – 1.) Jemilua Polius (Alabama A&M University)
"The Fabrication of Zinc Oxide Thin Films via Dipcoating Method for Energy Harvesting and Sensor Applications."

In this work, the sol-gel and dip coating methods were used to fabricate zinc oxide (ZnO) films on quartz (SiO2) substrates under normal laboratory conditions. The thin films were synthesized via the sol-gel method. The substrates were cleaned and casted using the dip coating method. Two cast films were prepared: one unannealed and the other annealed at 500°C by direct insertion in a furnace operated under atmospheric conditions. FTIR and Raman analysis of the resulting films were made to monitor the decomposition and oxidation reactions that occur during the fabrication process as well as process stability. It was determined that further adjustments must be made to the annealing perimeters to produce ZnO films in a simple and low cost method produce a n-type material for use in energy harvesting or other sensor application. This research experience has given me the knowledge base, foundation, tools and the confidence I need to pursue my current degree program, which is research based and ultimately will provide me with the expertise I need to contribute to my field of study in the future. We greatly acknowledge the support of Alabama Space Grant Consortium funding for supporting this research.

#21 – 2.) Eric Carter (Morehouse College)
"CDI cell Ionization and Desalination"

At Lawrence Livermore National Laboratory (LLNL), work was conducted on a project called Capacitive Deionization (CDI) and Desalination for cells in a parallel stack. The purpose of this project was to design a more efficient cell stack that would be used in the desalination process. This project required developing an initial design for the parallel CDI cell stack. The design for the parallel CDI cell stack was then compared with the original design for the series CDI cell stack. The next phase of the project required designing various components for the CDI cell stack. The assembly of the parallel CDI cell stack was composed of carbon electrodes, a fabric separator, and graphite strips. These internal components were essential to the desalination process. This process was repeated to create a full parallel CDI cell stack. At Morehouse, we are exploring a new project which entails finding the optimum growth parameters used to obtain highly-ordered metal-oxide nanotube arrays. One of the growth parameters for the current Morehouse project is an electrolyte solution, with varying degrees of concentration. Knowledge obtained from the desalination project at LLNL will be used to explore ways to design a filtration system for removing contaminants from an electrolyte solution used a source medium for obtaining nanotube arrays. This filtration will be tested against traditional cleaning and filtration methods.

#22 – 3.) Yasin Abdulkadir (University of California, LA)
"Development of a novel molecular probe for quantitation of DNA binding proteins in solution"

The interaction of proteins with nucleic acids plays an essential role in key biological processes including transcription, recombination, mechanism of replication, and translation. The processes themselves, their robustness and regulation rely on the specific recognition of the nucleic acids by the protein. The most frequently used technique to study protein – DNA interaction is the Electrophoretic Mobility Shift Assay (EMSA); however, it requires radioactive analysis, which is a practical drawback. Past research conducted in this lab has shown that by constructing a molecular probe from an enzyme, Renilla Luciferase (RLuc), and a DNA "molecular spring", a specific DNA target sequence can be detected in one step homogenous assay. In this study, we extend this concept and use the RLuc-DNA probe to detect and quantitate protein binding to a specific DNA recognition site. As a proof of principle, the restriction enzyme Hind III was used as the DNA Binding Protein (DBP). When Hind III is in solution with the molecular probe constructed, it interacted with the double stranded DNA (dsDNA) of the probe. This interaction changed the rigidity of the dsDNA which intern exerted mechanical stress on the RLuc reducing the activity of the RLuc. This novel technique should allow to study protein-DNA binding with a single step detection process in a homogeneous assay that would eliminate the need for radioactive probes.

#23 – 4.) Sean Snowden (Hampton University)
"The Role of Hyaluronan in Cellular Adhesion"

The hyaluronan in the glycocalyx of a cell plays a physical role in cellular adhesion and detachment. The factors regulating adhesion and migration have been extensively studied, hyaluronan - a high molecular weight and microns long polysaccharide forming the pericellular matrix around migrating cells, has been mostly neglected. Our data suggest that hyaluronan at the cell-substrate interface regulates the adhesion strength by exerting repulsive forces counteracting focal adhesions. Multicellular life depends inherently on cell adhesion and its dynamic mediation of cell interactions with other cells and with the extra cellular matrix, including cell migration and related processes like wound healing, embryogenesis, and cancer metastasis.

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CONDENSED MATTER & MATERIALS POSTER SESSIONS:

#25 – 1.) Pheona Williams (Howard Univesity)

"Temperature-dependent Raman Spectroscopy of Doped and Undoped Topological Insulators"

Topological insulators, materials whose bulk interior is insulating but have an unusual two-dimensional electronic state at the surface, represent a new class of quantum materials now being intensively investigated. The objective of this work was to study how the introduction of magnetic dopants affect the Raman response of topological insulator thin films in terms of spectral peak position and linewidth. We performed temperature dependent Raman spectroscopy on 8nm thick doped and undoped samples of capped Bi2Te3 thin films grown by molecular beam epitaxy. The dopants used were Cr and V at 2% and 4% replacement of Bi. We describe the effect of this doping on the position, and full width at half maximum of the observed thin film spectra. From the analysis of the temperature dependent Raman response, we suggest that this behavior can be understood in terms of doping-induced strain. This study revealed information about the lattice dynamical properties of Bi2Te3; in particular, how these properties evolve with the manipulation of metallic and transition metallic atoms in the topological insulator lattice.

#26 – 2.) Khalil Bryant (University of Michigan)

"Aspect Ratio Driven Optical Properties of Glancing Angle Deposited Thin Films"

Coherent arrangement of nano-structures have been the subject of many research projects, such as development of solar cells, sensors, fuel-cells, and supercapacitors. The optical properties of slanted columnar thin films (SCTFs) are dependent on the thickness of the film and therefore the aspect ratio of the constituent columns of the film. Anisotropic Bruggeman Effective Medium Approach (AB-EMA) is employed to analyze Mueller matrix spectroscopic ellipsometry data and to determine both physical and optical properties. The relationship between the optical constants along each of the major polarizability axes and the thickness of the SCTF are then explored.

#27 – 3.) Ifeanyi Ifeduba (Howard University)

"Fabrication and Measurement of the thermoelectric properties of cobalt oxide material doped with magnetic ion"

The properties and performance of Cobalt oxide material as a p-type semiconductor for commercial use depends on (1) its stability at high temperature region and on (2) its excellent physical and thermoelectric properties. Here in, we substituted (doped) and studied the effects of magnetic ions (Dy, Fe) for (Ca, Co) in polycrystalline Ca3Co4O9+ρ. A series of Ca3-xDyxCo4-yFeyO9+ρ samples was synthesized by the sol gel combustion reaction. The substitution of the magnetic ions was varied to introduce impurities in the lattice sites of the crystal structure of the cobalt oxide material (Co349). After preparation, the samples were subjected to heat treatment at different temperature. X-ray diffraction analysis confirmed the formation of a single phase for the base material and the presence of impurities as the amount of dopant increases. It also confirmed that the structure of the materials changes depending on the heating temperature. Electrical resistivity and Thermopower of the samples was measured using LR-400 four wire Resistance bridge and the MMR equipment. The obtained values of the resistivity for all samples falls within the range of a semiconductor. The thermopower values are all positive, indicating that the majority carrier are holes.

#28 – 4.) Anthony Coleman (Chicago State University)
"STEM Imaging and Composition Mapping of Multiferroic Oxides"

Materials that couple electric and magnetic ordering create interesting possibilities for the next generation of data storage technologies. However, there are few of these multiferroic materials that exist at room temperature, and even fewer with strong, coupled polarization and magnetization. One promising avenue to develop these materials is through oxide molecular beam epitaxy, which can generate new combinations of properties through heterostructures and interface phases. Here, we combine the ferroelectric LuFeO3 with the ferrimagnetic CoFe2O4 into a superlattice to develop a material with spontaneous polarization and magnetization above room temperature. To study how these materials are layered at the atomic scale, we use scanning transmission electron microscopy (STEM) combined with x-ray energy dispersive spectroscopy (EDS) and electron energy-loss spectroscopy (EELS). We map the elemental profiles through the film and across the bottom electrode to determine the relation between interdiffusion and growth conditions, which provides critical feedback for further growths.

#29 – 5.) Jumel Jno Baptiste (Grambling State University)
"Magnetization of Aqueous Plasma Synthesized Samarium Cobalt Nano Particles"

SmCo 5 nanoparticles were synthesized using aqueous plasma techniques to make strong magnets using additive manufacturing. As-synthesized particles exhibited oxidation therefore, the Nano-powders were reduced by flowing dry hydrogen gas at 400°C for 5 hrs. The magnetization properties of the reduced powders were compared with that of commercially obtained micron size SmCo 5 powders. The magnetization of aqueous plasma synthesized/reduced powder is higher than commercial powder but with lower coercivity which may be because of the super paramagnetic nature at Nano-size. The commercial powder was used to optimize parameters to make solid samples using arc melt and laser melt techniques. The magnetization of the arc melted particles increased drastically. Also, laser processed melt at 50-watts showed an increase in magnetization, while the 75-watts melt showed little to no change. Unfortunately, the coercivities of both laser melted and arc melted samples decreased significantly. This may have been because of oxidation during the melting process and evaporation of some Sm. Additional Comments: The work is funded by the NSF EPSCoR CIMM project under award #OIA-1541079.

#30 – 6.) Melia Kendall (North Carolina State Univesity)
"Macro and Micro: the Effects of Active Particles on Granular Materials"

Granular materials exhibit strange behaviour. For instance, a heap of sand is able to stay fixed but can also be poured, exhibiting both solid and liquid-like properties. Similarly, a pile of flour will stay dormant if undisturbed. However, active matter behaves very differently; flocks of birds, schools of fish, and other living organisms exert mechanical forces that cause systems to move. Introducing active particles to a granular material will change the behaviour of said material. For active particles in our study, we used the larvae of Tribolium confusus, the confused flour beetle. Motivated by the movements of the beetles, we seek to understand how individual motion of active particles affects the macroscopic motion of its environment. We perform experiments by adding active particles into grains of varying sizes - flour, flaxseed, and bulgur to test the importance of the relative size of active/inactive grains. In order to detect particle scale activity, we use Diffusing Wave Spectroscopy (DWS). By observing the changing reflections of a laser on the larvae we determined the time scale of correlations in the larval movements. To measure bulk scale flows, we designed an apparatus that permits us to observe the flow of larvae in several grain mediums, and record the macroscopic flows. We report the relationship between these two time-scales.

#31 – 7.) Donovan New (Pomona College)
"Developing a wearable piezoelectric generator"

A piezoelectric material is one in which mechanical stress or pressure can be used to produce electricity. When a piezoelectric material is compressed, a voltage is produced due to a distortion of the crystal lattice. While piezoelectricity has been studied since the 1880s, there has been recent interest in this type of material as a means of generating power. In this modern era of mobile technology, it is increasingly beneficial to produce electricity whenever and wherever we can. In this poster, we discuss a plan to research how piezoelectricity can be used to harvest energy from the motion of the human body, which is typically untapped. Taking advantage of recent advancements in small and lightweight technology, we plan to experiment with various ways of applying piezoelectricity to wearable devices. Specifically, we will present a plan to experimentally quantify methods of harvesting energy using piezoelectricity. We will explore a range of materials that may be used for these purposes. By designing hardware that will be attached to various parts of the body, we will be able to compare the power-generating capabilities of each device. With an accompanying display, we will provide real-time results on the amount of electricity generated. We hope this experiment will allow us to develop a device with real-world applications while adding to our knowledge of solid-state physics.

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NUCLEAR & PARTICLE POSTER SESSIONS:

#33 – 1.) Kalisa Villafana (Florida State University)
"A detailed spectroscopic analysis using fusion evaporation reactions to study the high-spin structures in 179,180W and a systematic analysis of backbending, seniority, and the Pauli blocking of pairing correlations at high rotational frequency in rapidly rotating Er, Yb, H and W nuclei."

High-spin states in 179,180W (Z=74) were produced via fusion evaporation reactions carried out at the Florida State University's John D. Fox Laboratory. To produce the nuclei of interest, a 14C beam was impinged on a 1mg/cm^{2} 170Er target, at beam energies of 75MeV and 68MeV respectively. The emitted gamma-rays were detected using three escaped-suppressed clover detectors and seven single element escape-suppressed high-purity germanium detectors. As a result of this analysis, new decay transitions and new energy levels have been observed in both nuclei building on previously known structures. The analysis of this data using gamma-gamma and gamma-gamma-gamma coincidences was done using the Radware analysis package. Additionally, due in part to results obtained from this analysis, new systematic data in the A~180 region is also discussed, with an emphasis on the role that pair-blocking effects play during the rotation of the nucleus. This systematic investigation builds upon the classic findings of Garrett et al., who investigated systematically the critical band crossing frequencies of the first pair of i_{13/2} neutrons (AB) in rare-earth nuclei. The present work carries out a similar comprehensive investigation for the second pair of aligning i_{13/2} neutrons (BC) at higher rotational frequencies.

#34 – 2.) Mackenzie Stewart (Chicago State University)
"Design of the dark box and testing of MCP-PMT"

With the LHC going on the long shutdown, we are able to do upgrades to the Fast Interaction Trigger (FIT). Which will be used as the primary forward trigger, luminosity, and collision time measurement detector. FIT will consist of two Cherenkov radiator arrays with MCP-PMT sensors. FIT is expected to match and even exceed the functionality and performance currently secured by three ALICE sub-detectors: the time zero detector (T0), the VZERO system (V0), and the Forward Multiplicity Detector (FMD).Performed testing on a reference MCP-PMT which is a older model and a current one, to test if they are detecting Cherenkov radiation. By enclosing the MCP-PMT in a dark box with a laser pointing at them we should be able to test the intensity of said radiation. The outcome of this for us to replicate the design of the dark box and testing of MCP-PMT so that it could used as a backup in case of failures with the original.

#35 – 3.) Rohan Lopez (Pomona College)
"Developing a Quantum Efficiency Measurement System for LAPPD (Large-Area Picosecond Photodetectors)"

Large area picosecond detectors can be developed and applied to detect photons in fields like science and medicine, allowing improvement in the speed and quality of photon detection. The development of the detectors includes building a vacuum environment for assembly of the detector, use of the most optimal material in each part of the detector, and the ability to very precisely test the detector. In this work, we adjusted the quantum efficiency setup for testing the effectiveness of the photocathode in the detector as well as various tasks such as manifold maintenance and data collection updates. Specifically, for testing quantum efficiency we developed a process for testing the tile at various points and plotting that data. Currently, we now have a solidified process for testing the quantum efficiency of the tiles as they become more developed over the coming months. The detector development is not complete yet, and currently the lab is undergoing a new mechanical procedure to change the sealing procedure.

#36 – 4.) Waymond Smoot (Duquesne University)
"Simulations of High Energy Particle Collisions with Aerogel in a Ring Imaging Cherenkov (RICH) detector"

Simulations for high energy subatomic charged particles passing through Aerogel radiators for experiments at the Thomas Jefferson National Accelerator Facility, Jlab, were performed at Duquesne University. These aerogel radiators are being used in a Ring Imaging CHerenkov (RICH)detector of the CLAS12 spectrometer. Cherenkov radiation will be generated by electrons and charged hadrons like pions and kaons traversing the aerogel at a speed bigger than the light phase velocity in a dielectric medium. I will be presenting the results of simulating different particles passing through the radiators using GEMC, a high energy particle detector simulator. Data collected from these simulations will be stored into output files through the use of bash script, which will be then converted into evio files through the use of a groovy script.

#37 – 5.) Quahhar Fletcher (Morehouse College)
"The Application of electrodeposition to produce uniform deposits"

Inertial confinement fusion (ICF) is a viable future format for sustainable energy. One of the major current research platforms on ICF utilizes metal shells as a means to achieve fusion. The metal shell plays a significant role in ICF, therefore, it comes with a number of critical requirements. The major requirements are that the metal shells should be round, leak-tight, and uniformly smooth. Electrodeposition, a choice method for obtaining smooth, uniform, metallic coatings on non-planar surfaces, was used in this study for gold shell fabrication on multiple types of round mandrels. Physical vapor deposition is another method researchers use for shell fabrication but it comes with many drawbacks. Electrodeposition was chosen due to its variables being easily manipulated. Furthermore, as it relates to the overall plating of the mandrels, electrodeposition effectively covers the mandrel with layers of gold. A specialized hand sewed cathode cage was employed to keep the spherical mandrels in motion, contained them within the cage, while it also provided contact points to allow for electrolytic plating. In this study, we varied several parameters, (i.e. bath agitation, plating rate, etc.) to determine the most efficient process to obtain round, smooth, leak-tight gold shells. The techniques used will be incorporated into experiments to act as a basis on producing uniform high-ordered nanotube arrays.

#38 – BLANK SPACE

SPECIAL RESEARCH TOPICS POSTER SESSIONS:

#39 – 1.) Tamia Williams (Ohio State University)
"Intersection of Identity and the Performing Arts of Black Physicist"

How one negotiates their physics identity is crucial to gaining and maintaining membership in the physics community. However, there is an exclusive culture of physics that has marginalized Black people, leading them to feel that they do not fit the criteria of who a physicist is supposed to be. To understand what keeps Black physicists in the field, we must analyze their physics experiences. Studies show that the arts can act as an identity mediator or coping mechanism for underrepresented groups in STEM. In this work, building on previous studies, we collect and analyze interviews of thirteen Black physicists. We find themes that relate to the ways in which Black physicists participate in the performing arts. We map those themes onto the previously-developed Critical Physics Identity (CPI) framework in order to understand how the arts have impacted their physics identities.

#40 – 2.) Kennedy Kishumbua (Morehouse College)
"Design of Pitch Plunge Device for Aeroelasticity Experimentation"

Investigations display that aircraft experience stress. Aeroelasticity is characterized by the distortion (as from bending) in a structure (such as an airplane wing or a building) caused by aerodynamic forces. Aerodynamic forces deal with the motion of air and other gaseous fluids and deals with the forces acting on bodies in motion relative to such fluids; which cause a major problem called flutter. Flutter is a dynamic instability of an elastic structure in a fluid flow, caused by positive feedback between the body's deflection and the force exerted by the fluid flow. So how does flutter work? An airplane wing is a very elastic part on the plane and since each wing supports about half of the plane's weight; when the aircraft experiences gust, it gets shaken up and down and the wings are flapping up and down because of inertia. The up and down movement is called flutter. To analyze these effects, our project is to design a pitch plunge device to be put in a controlled environment, like a wind tunnel, and establish a causal relationship between flow over the wing attached to the pitch plunge device and the resulting motion of the wing. From this project, we can acquire how to tailor structural designs to mitigate aeroelastic effects such as control reversal and flutter or build active systems which counteract these effects.

#41 – BLANK SPACE

TUESDAY, NOVEMBER 6

ASTRO, COSMOLOGY & EARTH SCIENCES POSTERS SESSION:

#1 – 1.) Terrence Pierre Jacques (West Virginia University)
"Using Population Simulations to Place Constraints on Black Hole - Pulsar Binary Systems)"

We are using the open-source package PsrPopPy to simulate populations of black hole - pulsar binary systems. The initial physical parameters for these pulsars make use of standard models for spin-down widely used in modeling the isolated pulsar population. We also make use of the StarTRACK package to obtain realistic binary parameters from stellar population synetheses. We then model previous pulsar surveys to determine which pulsars from our simulation may be detected. The populations of detectable pulsars is being used to allow us to place constraints on the black hole - pulsar binary systems and make predictions for future detections by ground-based gravitational wave detectors.

#2 – 2.) Gabriella Agazie (West Virginia University)
"The Swinburne Encyclopedia of Radio Pulsars"

The Swinburne Encyclopedia of Radio Pulsars (SERPS) is a comprehensive database of radio pulsar information that was created by West Virginia University students Gabriella Agazie and Olivia Young during the summer of 2018 through NANOGrav's IRES program. The project was overseen by Dr. Matthew Bailes at Swinburne University of Technology in Melbourne, Australia. SERPS displays information from the ATNF Catalog, the European Pulsar Network Catalog, and Shami Chatterjee's pulsar parallaxes table. For every published radio pulsar there are plots on spin period, binary period, proper motion, flux, and location of a particular pulsar in relation to all other known pulsars in the galaxy. Each page also contains links to the ADS database that show every publication that references a particular pulsar as well as the paper of discovery. For the majority of the southern sky pulsars we have timing residuals, ephemerides, and pulse profiles that were generated from data taken on the Molonglo Synthesis Telescope, which is primarily run by Swinburne University students.

#3 – 3.) Rishap Lamichhane (Howard University)
"OBSERVATIONAL STRATEGIES FOR JAMES WEBB SPACE TELESCOPE IN DETECTING KILONOVAE"

ASTRO A kilonova occurs when two neutron stars merge into each other. The neutron-rich ejecta from the merger undergoes a rapid (r-process) nucleosynthesis which leads to the formation of heavy elements such as gold. The radioactive decay of the unstable nuclei powers the kilonova emission in the optical and near-infrared spectrum which peaks at longer wavelengths. Short duration Gamma-ray bursts (sGRBs) are thought to be caused by this merger along with the gravitational waves. Thus, the kilonova emission is a promising electromagnetic counterpart for the future gravitational wave detection from binary neutron star mergers. James Webb Space Telescope (JWST) is equipped with Near Infrared Camera (NIRCam) and Mid Infrared (MIRI), which can be used to get crucial information on kilonova and the synthesis of heavy elements. In this project, we create a distribution of kilonova models and their host galaxies based on published observational data/models and design optimal observation configurations using the JWST Exposure Time Calculator (ETC). We will calculate the exposure times to achieve the required signal to noise ratio (SNR) for these configurations. The results will be used to investigate the observation strategies for the future kilonova studies using the JWST to unravel the origins of heavy elements in the universe.

#4 – 4.) Sara Negussie (University of Maryland)
"Is the Solar Magnetic Field Getting Weaker?"

Recent work (Gopalswamy et al. 2014) suggests that coronal mass ejections (CMEs) are expanding anomalously in solar cycle (SC) 24 due to the reduced total magnetic pressure in the ambient medium. One of the consequences of the anomalous expansion is reduced magnetic content in magnetic clouds (MCs). MCs are one of the primary causes of a Forbush decrease (FD). A FD, typically observed by ground-based neutron monitors, is a sudden asymmetrical decrease in galactic cosmic ray background flux, followed by a gradual recovery. Thus, a comparison of FDs and their associated MCs in SC23 and SC24 should illustrate the differences in the solar magnetic field between the two solar cycles. We present preliminary results from a survey of FDs, of all magnitudes, observed by the Oulu neutron monitor, that can be associated with MCs in SC24 compared with those in SC23. Our study showed that while a similar number of small (≥2%) FDs were observed in both solar cycles, 29 in SC23 and 24 in SC24, only 37.3% of them were large (≥5%) FDs observed in SC24 as compared to 12.5% in SC23. The median magnitude of FDs in SC24 was 2.81% (~ 4.33% in SC23). The median peak magnetic field of FD associated MCs was ~21.09 nT for SC24 as compared to ~24.99 nT for SC23. The median peak speed of the associated MCs was ~542.85 km/s in SC24 (620.3 km/s in SC23). Thus, SC24 had FDs with subdued magnitude and their associated MCs had a weaker magnetic field.

#5 – 5.) Romy Rodriguez-Martinez, (Ohio State University)
"Finding Flares on M dwarfs with ASAS-SN"

Stellar flares are sudden, rapid events on the atmospheres of stars that can generate copious amounts of radiation across the electromagnetic spectrum. They occur when charged particles interact with the plasma in the stellar surface and are accelerated by internal magnetic fields. Modern astronomical surveys have revealed that stellar flares are prevalent, particularly on M dwarfs, which are low-mass stars that display a high frequency of flare events. Magnetic phenomena such as flares, star spots and coronal mass ejections can complicate the detection of exoplanets and can erode the biosphere of potentially habitable planets. Our research aims to quantify the flare frequency and energy of a sample of ~1,300 bright, nearby M dwarfs using data from the All-Sky Automated Survey of SuperNovae (ASAS-SN). Our preliminary results show that about 400 M dwarfs have had potential flares in the last 6 years. As the first systematic study of M dwarf flares in a large sample, our findings suggest that these events are common and have a wide distribution of energies.

#6 – 6.) Angelina Gallego (Hampton University)
"Analysis of Wind and Clouds on Jupiter using the Cassini ISS Visible and Near-Infrared Camera Images"

We present preliminary results on cloud tracking wind measurements as well as morphology of atmospheric cloud bands and vortices on Jupiter. We use images captured by the Imaging Science Subsystem (ISS) onboard the Cassini spacecraft during the spacecraft's flyby in 2000. Our primary objective is to demonstrate the scientific utility of images captured in broad-band color filters such as red (RED on ISS), green (GRN) and blue (BL1 and BL2). Our work can be applied to preparation for missions like the Europa Clipper currently planned for launch in 2022 or later. The Clipper's main imaging camera, Europa Imaging System (EIS), is expected to image Jupiter as a calibration target; however, the camera is equipped only with broadband filters. The filter performance of EIS is similar to those of ISS. Thus, our project lays the groundwork in preparation for analyzing the broadband color images of Jupiter to be captured by Clipper.

We analyze images captured using the aforementioned broadband filters, as well as the narrow-band CB2 and MT2 filters on the Wide- and Narrow-Angle Cameras. In our wind measurements, we apply a 2-dimensional correlation imaging velocimetry, which determines the motion of clouds between a pair of images by searching for a peak in two-dimensional correlation coefficient as a functional of horizontal displacement from a given point. In our cloud morphology analysis, we visually inspect and document the shapes and colors of cloud bands and vortices so that they can be compared against results of current and future missions like Juno and the Europa Clipper.

#7 – 7.) Hilary Utaegbulam (University of Houston)
"Variability of the Balmer Emission Lines in T Tauri Stars"

Classical T Tauri stars (CTTSs) are young, roughly solar mass, premain sequence stars (PMS) that have only recently emerged from their natal molecular cloud cores to become optically visible. Most, if not all, low mass stars, including the Sun, go through a CTTS stage in the first few million years after they are born. It is during this time that planets form in the accretion disks that are found around CTTSs. In addition to forming planets, most of the material in the disks either accretes onto the star or is removed in an outflow, but the exact nature of these flows remains poorly understood. The Balmer emission lines of CTTSs form in these accretion and wind flows, and the strength and shape of the Balmer emission lines varies substantially with time, offering a means to better understand these flows. Here, we analyze the variability of the main Balmer lines in the CTTS BP Tau in order to better understand the accretion and wind flows of this young star.

#8 – 8.) Andre Nottingham (Morgan State University)
"Cosmology Large Angular Scale Surveyor"

For centuries "How old is the universe?" and "what does the universe contain?" were questions for many. A major part of astronomy that answers these questions is the cosmic microwave background. The cosmic microwave background (CMB) is electromagnetic radiation that is left over from an early stage of the Big Bang cosmology. CMB radiation can be studied to help us gain a better understanding of how our universe started. The Cosmology Large Angular Scale Surveyor (CLASS) aims to measure the CMB polarization to find Inflationary gravitational waves to understand how the universe began. CLASS uses four telescopes that are located in the

Andes Mountains of northern Chile. These telescopes focus on measuring different microwave wavelengths of the CMB to map over 70% of the sky. My poster will explain how CLASS works and my role/contribution to the project.

#9 – 9.)Shekia Brower (North Carolina A&T State University)
"Modeling Foehn Winds and the Warming Effects in Antaractic Peninsula"

In Antarctic Peninsula (AP), significant warming has occurred, which caused an increase in the surface melting particularly along the east side of AP. This increased melting is partially caused by the foehn wind warming. In this study, the Weather Research and Forecasting (WRF) model with forcing data of ERA-Interim reanalysis is used to simulate the foehn wind warming in AP. In order to configure WRF simulation setup for this study, sensitivity simulations of double (10km-2km) vs. triple (50km-10km-2km) nesting are first compared. The comparison suggests that a double nesting domain setup is sufficient to conduct modeling study of foehn wind warming in AP with the ERA-Interim forcing. Then the Planetary Boundary Layer (PBL) schemes within WRF are tested for the study area through three simulation tests in which PBL schemes of Mellor-Yamada-Janjic (MYJ), Yonsei University (YSU) and the Asymmetric Convection Model 2 (ACM) are compared. The results suggest that the schemes showed very similar data and the MYJ scheme is chosen. Then the in-house configured WRF is used to simulate the foehn wind warming in AP with two case studies. Modeling results suggest that, WRF 2 km simulations provide descriptions of the cross mountain winds with warming alone the east side of AP. Comparisons of the WRF simulations and ERA-Interim reanalysis show that the WRF simulations capture better foehn wind effect warming in all nesting domains.

#10 – 10.) Hassan Mason (University of North Carolina Wilmington)
"Modeling Foehn Winds and the Warming Effects in Antaractic Peninsula"

Numerical models play a integral role in the study of ocean processes, especially in the Southern Ocean, which is remote and difficult to measure in situ. One important ocean process within the Southern Ocean is the production of Antarctic Bottom Water (AABW), which is a cold, dense water mass linked to the advective exchange of heat across the Antarctic continental shelf [1]. Here, the occurrence of AABW within the Parallel Ocean Program II / SeaICE (POPII/CICE) coupled ocean model is explored. A large-scale temperature comparison between the simulated shelf water and observationally predicted shelf water is presented, as well as a time series of potential temperature, salinity, and potential density values on the ocean section along the 156.5E longitude. The water mass found in the model displays physical properties and behavior that are very similar to observed AABW. The POPII/CICE model's reasonable representation of this complex process suggests that a future exploration of the advective heat transport around the Antarctic continent through this model is likely to provide valuable insight.

#11 - BLANK SPACE

AMO/POP POSTER SESSIONS:

#12 – 1.) Eshirdanya McGhee (Alabama A&M University)
"Thermoelectric Properties of Sb2Te3 Thin Films"

The efficiency of the thermoelectric materials (figure of merit, ZT) that found to be limited in bulk structures has shown an enhancement by introducing nanostructures such as nanowires, multilayers, and nanocomposites. ZT relies on the Seebeck coefficient (S), the electrical conductivity (σ) and thermal conductivity (K). Nanostructure thin films have shown enhancement in ZT then bulk thermoelectric materials. DC/RF magnetron sputtering technique was utilized to fabricate nano-scale thin films of antimony telluride (Sb2Te3) on SiO2 substrates using Sb2Te3 target. Thermal annealing was carried out to enhance thermoelectric efficiency by forming quantum structures within the films. The Seebeck coefficient, van der Pauw four-probe resistivity, mobility, Hall coefficient, density, measurements were performed, and power factor has been found to be improved in nano-scale thin films by thermal annealing. Thermal treatment showed positive effects on the thermoelectric properties of Sb2Te3 thin films on the selected temperatures. The findings will be shown during the meeting.

#13 – 2.) Tyler Jones (Pomona College)
"Defect Characterization of Organic Photovoltaic Cells"

Polymer based organic photovoltaic devices (OPVs) have attracted a great deal of interest because of their mechanical flexibility, tunable material properties, and potentially low cost, with demonstrated efficiencies of up to 10.6%. However, non-uniformities and defects can decrease the operating efficiency, and exposure to oxygen and moisture under working conditions can progressively degrade the cells over time. In this work, the use of highly spatially resolved thermoreflectance imaging to characterize electrical shunts and other defects in P3HT-based photovoltaic cells is demonstrated. Examining the thermal signature of a defect in response to sweeping the cell bias conditions, together with more conventional means of characterization including IV curves and electroluminescence imaging, provides a powerful tool for characterizing the types and physical origins of defects present in the cells. In particular, defects that cause electrical shunts, or areas of localized low resistivity, can be seen as hot spots in the thermoreflectance images. Furthermore, we show that the effects of thermal conductivity and diffusion away from the hot spots can be extracted from the thermoreflectance images, and characterize the detected shunts as resistive versus diode-like.

#14 – 3.) Kyron Keelen (Morehouse College)
"Fabrication and Characterization of GST"

Spatial light modulators (SLMs) are electro-optical devices which can change the lateral distribution of their complex transmittance depending on either electrical or optical external signals. A common use of SLMs are in cameras. Light enters a lens and is displayed on a sensor which translates the light from optical information into electrical data, later rendering as a reviewable image. Current spatial light modulator are made using liquid crystals which produce low switching speed and high energy consumption in devices. Strides are being made to develop a phase change material to replace liquid crystals in spatial light modulators. The phase change material being investigated is germanium-antimony-tellurium, GeSbTe, or GST. The measuring the resistance of GST samples along with obtaining the contact resistance measurements of contacts composed of tungsten, Titanium nitride, molybdenum and others are are the methods of characterization being used. The goal is to fabricate GST with a contact resistance compatible with 50 ohm devices but GST in the amorphous state can presently only reach megaohms.

#15 – 4.) Alexis Bullock (Norfolk State University)

"The Growth of Organic Lanthanide Crystals for Nano-Optics Studies"

The purpose of the experiment is to grow organic lanthanide crystals to use for Nano-Optics Studies and perform excitation spectra on the crystals. Organic Crystals were produced from the following lanthanides Eu,Gd,Nd,Tm,Er,La,Yb, with the addition of 2,2 bipyrimidal. The lanthanides were able to grow under two different methods seed crystal method and slow evaporation at room temperature method for crystal growth. Then the crystals that were produce using the various methods were placed onto a slide to be observed under the optical microscope. Pictures of the quality crystals were taken and measured in length and width in micrometers. The lanthanide crystals Europium, Neodium, and Erbium were used for Emission spectra at UV excitation. These crystals can be used to fabricate thin films and are excellent samples for nan-optics studies.The crystals quality demonstrated high efficiency of luminescence and are suitable for film fabrication. Overall these crystals can be used to fabricate thin films and are promising for Nano-optics studies.

#16 – 5.) Marvin Clemmon Jr. (Norfolk State University)
"Ultra-thin films with Eu for nanophotonic studies. Fabrication and effect of the substrate."

Lanthanide complex, Eu(TTA)3(L1a) presents interest for various applications due to the record-high luminescence efficiency in the visible range, and well distinguishable spectral lines associated with electric and magnetic dipole transitions. In our work we explore the possibility to use Langmuir-Blodgett (LB0 technique for fabrication of Eu(TTA)3(L1a) monolayers and multilayers, and study optical properties of monolayer films deposited onto different substrates. During the LB procedure, the material spread onto water surface demonstrates the area-pressure isotherm, typical for amphiphilic materials. After the compression, the "solid" molecular layer formed on the water surface is transferred to the substrate by immersing it from the top or lifting from the bottom. We are able to see significant emission even from the monolayers. Modification of local optical environment in close vicinity of metal is expected to have different effects on optical dipoles, emission rates, spectra, and energy transfer processes. The first results show significant difference in the spectral behavior of the films deposited onto glass, silver and gold and nanostructured gold.

#17 – 6.) Kadeem LaFargue (Allegheny College)
"An Investigation Of Elliptical Polarization Arising From The Optical Properties Of Liquid Crystals"

This report describes the individual and independent experience of studying elliptically polarized light through holographic gratings filled with dye-doped liquid crystals. Though I faced some difficulties, I did obtain data to prove the elliptical polarization of the light while also educating myself on liquid crystals and their endless ensemble of properties that help create that. Though I didn't find the information I was looking for through this study, I did spend time looking at the liquid crystals and finding ways to use them as building blocks for future potential research.

#18 – 7.) Brandon Harris (Ohio State University)
"Laser Ablation of Bulk Gallium Oxide and Gallium Nitride"

Gallium Oxide (Ga2O3) and Gallium Nitride (GaN) are unique in the sense that they are wide band gap semiconductors with band gaps of 4.9eV and 3.4eV respectively. Both materials have applications in the field of tera-hertz and peta-hertz electronics. A crucial aspect to these applications is to understand the AC breakdown behavior of these materials in the optical frequency range. We have investigated ultra-short laser induced damage thresholds for Ga2O3 and GaN through via experimentation and theoretical simulation. Bulk Ga2O3 and GaN were exposed to a 9 fs laser pulse centered at 760 nm. Both single and multiple shot tests were done for comparison. To more accurately determine the excited carrier density criteria in which visible laser damage occurs, we simulated carrier excitation dynamics for the entire laser pulse as it interacts with the target. Our simulation uses the Keldysh model of ionization in order to determine the conduction band electron density, which is commonly used as a threshold criterion for laser damage. The simulation results when compared to our experimental data show that once the conduction band reaches an electron density of approximately 5-10% of the total valence band electron density,optical breakdown and damage is likely to occur.

#19 – BLANK SPACE

CHEMICAL, BIOLOGICAL & MEDICAL PHYSICS POSTER SESSIONS:

#20 – 1.) Azia Barnes (University of Wisconsin-Milwaukee)
"Effects of Beta & Gamma Radiation on pGlo Plasmids"

UW-Milwaukee's RockSat-C experiment exposing plasmid to radiation during outer space flight in 2017 showed in preliminary results, that transformation rates of E. coli by pGLO plasmids increased with increasing exposure to gamma and beta radiation. Following the 2017 results, the team hypothesized that the radiation exposure changed the structure of the DNA pGLO plasmid, allowing it to transfer to the E. coli more easily. If the structure of plasmid DNA is altered by radiation, then bacterial transformation rates by plasmids could also be affected. Effects of gamma and beta radiation on bacterial transformation rates may be seen through changes in plasmid structure and conformation. The ability to detect changes in the chemical compounds of irradiated DNA plasmids is paramount to understanding how their structures are affected by radiation. In this literature review we will discuss the DNA plasmids topology, FTIR spectroscopy "fingerprints", and conformations to explain the increase in transfer rates and the maximum amount of radiation a DNA plasmid can withstand. By using Fourier Transform infrared spectroscopy we will compare the fingerprints of the conformations B-DNA: supercoiled, closed circular, and linear to the fingerprints of the experimented plasmids. The experiment group will consist of the unshielded group - B-DNA plasmids exposed to gamma and beta radiation during RockSat-C sounding rocket launch, the shielded group - B-DNA plasmids exposed to gamma radiation only, and the control group - B-DNA plasmids not exposed to either gamma or beta radiation

#21 – 2.) Lewis Campbell (Georgia Institute of Technology)
" Developing a Robust "Breaking Point" Metric for Ant Excavation Robots"

The purpose of this research project is to discover metrics that can be used to evaluate the maximum amount of stress ant excavation robots can handle to develop parameters for operation. The sensory damage caused by collision was the primary focus because it was the most apparent form of stress the robots undergo. We began the process of differentiating the types of contact to observe the correlation between both frequency and type of contact and sensory performance.

However, due to the limited time available, we could not conclude the most intuitive way to differentiate the contacts. Research will continue with testing new mediums to differentiate contact type, then experimentation will develop to begin observing the effect of frequency of contacts.

#22 – 3.) Aaron Bourique (University of Florida/Georgia Institute of Technology)
"Modeling and Experimentation of Turing Patterns in Semi-Arid Vegetation Growth and Other Biological Systems"

The universality of pattern formation lends to its widely diverse range of applications, notably vegetation patterns. Vegetation patterns have been observed in arid environments, ranging from spotted or isolated distribution to intricate, labyrinth-like formations. These pattern formations are thought to be Turing-based, being determined by global plant biomass and water infiltration variables that behave as reaction-diffusion equations. However, since these have not been replicated in controlled environments, our research focuses on replicating these patterns in a controlled lab environment with varying amounts of water to provide support for the existence of these patterns, and at what levels of aridity they occur. Likewise, we model these formations using WebGL to further gauge the ideal levels of aridity for pattern formation, and provide support of existence of reaction-diffusion equations for these systems. This research was funded by the National Science Foundation as a part of a Research Experience for Undergraduates program at the Georgia Institute of Technology. Not only did the REU teach me valuable skills in computational physics, but also opened my eyes to opportunities available to me as a physics student. Before the REU, I didn't fully consider graduate school as an option for me after college; however, I now look forward to attending graduate school and have more direction in my career aspirations than ever.

#23 – 4.) Tracy Edwards (Hampton University)
"A natural language processing tool to automatically categorize radiation exposure data from computed tomography examinations"

Hospitals are required to monitor and track the radiation dose used for computed tomography (CT) examinations. Individual CT scanners send such information to a dose monitoring database after every patient is scanned. These raw data are potentially very valuable in understanding how imaging examinations are being performed in the hospital and to ensure optimal patient safety. However, the data are often difficult to analyze due to the inconsistent ways that various CT manufacturers organize and report the radiation dose information and due to the natural complexity of imaging data in a real-world radiology department. With over 100k examinations performed every year at some hospitals, there is a need for automated solutions to help clean up such data. Therefore, the objective of this study was to create a machine learning algorithm that can automatically categorize raw radiation dose data from a radiology department at a major academic hospital. The raw radiation dose data from 65,356 CT examinations was collected from the radiology department at Duke University Hospital. The data was organized in tabular format with each row corresponding to a radiation event and each column corresponding to either a text-based (Study Description, Institution name, Model Station Name) or numerical-based (CT dose index, Dose Length Product) descriptor of the radiation event. The goal was to train a model that could predict the category of each radiation event (scout, contrast timing, or diagnostic) based on these predictor columns. A decision-tree model was trained using the text processing tools in the Natural Langue Took Kit (NLTK) and the machine learning tools in the Scikit-learn Python package. Text-based columns of interest that contributed to predicating the scan purpose were vectorized (converted to numerical values) based on a Word2Vec word embedding algorithm.

Once vectorized, they were included with CT Dose Index and Dose Length Product as predictors of the scan purpose. Training data was manually labeled under the guidance of an expert clinical medical physicist and included 6,000 cases. Once the model learns which scan purpose label is associated with the each vectored column, it is then able to make a prediction for data it has not seen before. The model was able to achieve a 99% predication accuracy, demonstrating that such an approach is potentially valuable in helping to categorize and eventually analyze radiation dose data for the ultimate benefit of patients. Future work will focus on applying similar methods to better clean-up and categorize other aspects of the radiation dose data.

#24 – 5.) Tamia Williams (The Ohio State University)
"Intersection of Identity and the Performing Arts of Black Physicst"

How one negotiates their physics identity is crucial to gaining and maintaining membership in the physics community. However, there is an exclusive culture of physics that has marginalized Black people, leading them to feel that they do not fit the criteria of who a physicist is supposed to be. To understand what keeps Black physicists in the field, we must analyze their physics experiences. Studies show that the arts can act as an identity mediator or coping mechanism for underrepresented groups in STEM. In this work, building on previous studies, we collect and analyze interviews of thirteen Black physicists. We find themes that relate to the ways in which Black physicists participate in the performing arts. We map those themes onto the previously-developed Critical Physics Identity (CPI) framework in order to understand how the arts have impacted their physics identities.

#25 – BLANK SPACE

Condensed Matter & Materials Poster sessions:

#26 – 1.) Antone Davis-Correia (Morehouse College)
"Measuring The Speed of Light"

The experiment that will be taking place will measure the refraction index of jello. The refractive index will be defined as the ratio of the speed of light in jello by the speed of light in air. In this measurement both the speed of light in jello and air will be measured using a pulse diode laser source of light. In combination with a pin diode detector. The pulse laser signal is used to trigger the oscilloscope and also used as signal for channel 1. The second channel of the oscilloscope will monitor the signal from the pin diode detector. The speed of light measurement is carried out by measuring the delay of the pin diode signal with respect to the trigger signal. The delay is the distance between position one and position two. The speed of light in jello will be tested by freezing the jello in a narrow 1-meter pipe and send a laser through the pipe to the diode receiver on the other side which will give the data of the speed of light. The speed of light test will be tested on two different densities of jello. In this experiment the refractive index of jello will be measured as function of its density of the jello.

#27 – 2.) Austin Little (Morehouse College)
"Towards a real-time in-seat weight shift tracker"

A leading health risk for many wheelchair users -- especially paraplegics with poor nerve endings below the waist -- comes in the form of pressure ulcers, i.e., damaged areas of skin caused by staying in one position for an extended amount of time. During rehabilitation, these individuals are trained to perform periodic weight shifts to relieve this pressure. In this work we describe initial progress towards a real-time weight shift tracker that can monitor the activity of such wheelchair users. Our goal is to develop automatic methods for identifying and characterizing various forms of in-seat activity. A challenge in our setting involves the fact that while large amounts of field data are available, training data is somewhat limited. A key component of our proposed approach involves learning Hidden Markov Models (HMMs) in an unsupervised fashion for identifying the underlying states in the field data. We demonstrate some promising initial results for this approach.

#28 – 3.) Christopher Davis (Morehouse College)
"Eliminating Micro-plastics Using Electro-adhesion"

In this project, the construction of an electro-adhesion robot arm that will safely remove microplastics from one beam to deposit to another is proposed. Such a process will mimic the removal of microplastics from our environment. Electro-adhesion is an electrostatic attraction between to surfaces which results from an application of an electric field from two surfaces. The electro-adhesive material used in this project manufactured out of a special polymer. We propose to make these polymers. As part of the project, we will test the strength of the electric adhesion at different voltages which are safe to use in a lab. This technology has been applied to vertical wall climbing robots and other applications include electrostatic grippers used manufacturing assembly lines. This project will focus optimizing electro-adhesion to small plastics in varying shapes. We plan to apply electro-adhesion to smaller microplastics. We will optimize the electro-adhesion force, which allows us to manipulate deformable, fragile objects of any shape with a single control signal. The theory and operations of this device can be found in Griffiths article, "Wall Climbing Robots Using. Electro-adhesion Technology".

#29 – 4.) Johnathan Long (Kennesaw State University)
"Three-Dimensional Carbon Nanotube Photovoltaics"

With an increasing demand of decarbonization and renewable resources comes vastly expanding innovations in solar energy research. At any moment in time, the sun emits approximately 3.86∗〖10〗^26 watts of power onto the Earth's atmosphere. However according to the National Renewable Energy Lab, the commercially affordable second generation thin film solar cells reach maximum efficiencies of approximately 20%. The purpose of this research is to fabricate and test a new method of three dimensional solar cells using carbon nanotube fabrication. The fabrication of the photovoltaics in this research is comprised of a Molybdenum back contact, a single PN junction, a Zinc oxide resistive layer, and a transparent conductive oxide layer. Carbon nanotubes were grown onto the Molybdenum back contact adding a third dimension to the solar cell. This increased the probability of light being absorbed via a pinball effect. Most of our hands-on work came within the clean room as we worked with multiple deposition tools such as the CHA E-beam, the Denton explorer, the Vision RIE sketch tool, and the Black Magic tool. Using the Black Magic tool, we were successful growing carbon nanotubes onto Molybdenum and Silicon wafers. Further research would consist of a deeper analyzation of the relationships of carbon nanotubes' density and height to the temperature, growth time, and pressures within the growth process. Continued efforts would consist of layer analysis of the PN junctions, evaluating the most efficient layer of compounds to deposit onto the solar cell.

#30 – 5.) Kevaugh Johnson (Howard University)
"Generalizing bilayer interactions in transition metal dichalcogenides"

Transition Metal Dichalcogenides (TMDCs) are a well-known family of materials. They are expected be very useful in creating metamaterials with unique properties by stacking 2D layers of them with other materials. To better understand how to make these metamaterials we are investigating the interlayer bonding that takes place in 2D, bilayers of TMDCs using computational methods. Our theoretical model currently examines the p orbital interactions between the inner chalcogenide atoms. We limit the scope of our model to just the valence electrons of the inner chalcogenide atoms because the contribution from the core electrons of the chalcogenide atoms and the transition metal electrons is assumed to be negligible and would only increase the computational time required. These interactions form a 3x3 hopping matrix. For these calculations we are using Wannier transformations of density functional theory calculations for the tight-binding Hamiltonian for the TMDCs. Previously, this methodology was applied to MoS2. We have repeated the calculations for several TMDCs. The σ and π bond energy curves we constructed for all samples are similar to the MoS2 curves. The curves are robust, and the fits have small error values. This shows there may be a general form that can predict the bonding energy with respect to distance between the layers.

#31 – 6.) Jonalyn Fair (Southern University & A&M College)
"The Study of Electrochemical Durability of Carbon-Supported Pt Catalysts For Fuel Cell Applications"

Platinum (Pt) is the state-of-the-art catalyst for both anodic and cathodic reactions that occur in polymer electrolyte fuel cells (PEMFCs). Due to the cost of platinum, fuel cells have been hindered from commercialization. However, one obstacle for next generation fuel cells is to reduce the amount of platinum yet still produce tremendous activity and high durability. In this work we have investigated the effects of aging, with the use of an Accelerated Stress Test (AST) that consists of voltage cycles from 0.6 V to 1.0 V vs. RHE. Furthermore, we studied the electrochemically active surface area (ECSA) of different Pt loadings on carbon. In particular, we used a catalyst supported on a high surface area carbon, XC-72. We tested Pt catalyst of 4.8%, 20%, and 40%. These materials are used in the state-of-the-art PEMFCs. To study the activity and durability of the Pt catalyst, a rotating ring disk electrode (RRDE) system is used in stationary mode. Carbon monoxide (CO) is introduced into the RDE system because it is adsorbed onto Pt active sites and the ECSA of the catalyst can be calculated. The number of active sites can be determined by measuring the ECSA of the hydrogen adsorption and desorption regions, and CO stripping. Detailed examination of the results reveal that the various loadings of Pt on carbon supported do have an impact on the active sites. This was validated by the decrease in ECSA as the loading of Pt on carbon increased. In all tests, we observed ECSA losses as the number of AST voltage cycles increased.

#32 – 7.) Joshua Samba (Morgan State University)
"Identification of Defect Formation and Propagation Mechanisms in the Piezoelectric Crystals with Fluorescent Nanoparticles"

The typical soldier is required to carry up to 20 pounds of batteries on a standard 72 hour mission for the operation of electronic instruments on their bodies, making the batteries second in cost to munitions. Wearable piezoelectric power generators are gaining momentum in the recent years as an alternative solution for supplying the energy demand of the army personnel. Furthermore, piezoelectric crystals are commonly used in the operation of electronic components such as sensors and actuators. Defects in piezoelectric crystals can substantially hinder their performance, making the analysis of defect formation and propagation a critical task. In order to test nanoscale deformation and damage in piezoelectric crystals, nanowire based magnetic field sensor devices were fabricated. The external magnetic field induced mechanical deflections will be measured with the piezoelectric crystal thin films deposited on the devices. Fluorescent nanoparticles will be employed in the characterization of defect formation and propagation mechanisms in these piezoelectric crystal thin films under dynamic stress conditions. Based on the results of these tests, piezoelectric crystal material with the highest defect resistance will be identified to optimize the performance of nanowire based magnetic field sensors.

#33 – 8.) Nabil Jamhour (Rowan Unversity)
"Refining Catalysts & Gas Nozzle Design to Study Methane Soft Oxidation"

The typical soldier is required to carry up to 20 pounds of batteries on a standard 72 hour mission for the operation of electronic instruments on their bodies, making the batteries second in cost to munitions. Wearable piezoelectric power generators are gaining momentum in the recent years as an alternative solution for supplying the energy demand of the army personnel. Furthermore, piezoelectric crystals are commonly used in the operation of electronic components such as sensors and actuators. Defects in piezoelectric crystals can substantially hinder their performance, making the analysis of defect formation and propagation a critical task. In order to test nanoscale deformation and damage in piezoelectric crystals, nanowire based magnetic field sensor devices were fabricated. The external magnetic field induced mechanical deflections will be measured with the piezoelectric crystal thin films deposited on the devices. Fluorescent nanoparticles will be employed in the characterization of defect formation and propagation mechanisms in these piezoelectric crystal thin films under dynamic stress conditions. Based on the results of these tests, piezoelectric crystal material with the highest defect resistance will be identified to optimize the performance of nanowire based magnetic field sensors.

#34 – BLANK SPACE

NUCLEAR & PARTICLE POSTER SESSIONS:

#35 – 1.) Cassandra Little (University of Houston)
"Phase diagram of Hadronic matter in the Nambu Jona-Lasinio model"

We study the chiral phase transition of strongly interacting matter within the Nambu Jona-Lasinio (NJL) model at finite temperature and density. We compare a system with 2 and 2+1 quark flavors and discuss the changes in the phase transition line and the location of the critical point due to the presence of the strange quark.

#36 – 2.) **Ashley Brooks (Indiana University)
"Estimating the Cosmic-Ray Exposure of SuperCDMS Detectors"

ABS – To be added

#37 – 3.) Avi Kahn (University of Maryland)

"Using Geant4 to Study the Effects of Radiation Damage on Scintillators"

This project - performed within the CMS collaboration - involves the use of Geant4 to simulate absorption experiments conducted on scintillators at UMD. With this project we hope to create an accurate computer model of these measurements so that we can supplement our experimental data. In addition, the model can be used to study the effects of radiation damage at dose rates different from those explored experimentally, particularly the very low dose rate present near the CMS hadron calorimeter at the Large Hadron Collider (LHC).

#38 – 3.) Pierre Nzabahimana (Michigan State University – NSCL)
"Two_Alpha Correlation Function"

In heavy-ion collisions, Two-particle Correlation Function have been important tool to determine the size of two-particle emitting sources. The nuclear interaction between two emitted particles gives rise to resonance peaks in the Correlation Function (CF). In the $\alpha-\alpha$ CF, the resonance peak, which corresponds to the unstable ground state (G.S) of 8Be at relative momentum q =18 MeV/c, is due to S-wave interactions while the one corresponding to the 1st excited state of 8Be at q =108 MeV/c is due to D-wave interaction. We have solved the radial Schrödinger Equation (SE) to find the radial wave functions and the phase shifts (δl) for different partial waves (i.e., S-wave and D-wave for low energy reactions), which can be used to construct the full scattering wave function. This full wave function and the model source are subsequently used to compute the CF that, when compared to the experimental CF, allows to determine the emitting source distribution function. We will present preliminary results from this work.

#39 – 4.) Angel Christopher (Hampton University)
"A Dual Phase TPC/THICK-GEM Based Target To Study Unbound Nuclei"

The Facility for Rare Isotope Beams (FRIB) is currently being constructed on the campus of Michigan State University. When completed, FRIB will become an unprecedented low energy nuclear physics facility in the world to study neutron rich nuclei with heavy ion beams. The MoNA Collaboration, which consists of 11 institutions, has been involved at the National Superconducting Cyclotron Laboratory for almost two decades. Hampton University joined the collaboration in 2013 and led the development of a Si-Be segmented target that was used to measure the lifetime of 26O and neutron unbound states in the island of inversion using the invariant mass technique. This target provided for the first time detail information about the incident beam position and energy, before and exiting the Be targets to within 10%. A proposal to construct a dual-phase based time-projection chamber is being investigated by the MoNA Collaboration since it would increase the position and energy resolutions, and allow missing mass reconstruction by detecting the recoil fragments. Results from a realistic Geant4 Monte Carlo that include expected performances of this proposed target will be presented.

#40 – 5.) Dhanushka Rathnayake (Hampton University)
"Geant4 study of the electric field effect on the signals from GEM detectors"

In recent years, the nuclear physics group at Hampton University started the development of a series of detectors based on the Gas Electron Multiplier (GEM) technology for various experiments worldwide utilizing electron, hadron or heavy ion beams. Two major ongoing efforts are being held at the Thomas Jefferson National Accelerator Facility (Newport News, VA) and the National Superconducting Cyclotron Laboratory/Facility for Rare Isotope Beams (East

Lansing, MI). Some uses standard GEM geometries and others are based on TH-GEM geometries developed specifically for heavy ions. Monte Carlo simulations have been used in the past to understand the response of these detectors using unperforated single or multiple GEM foils to identify particles interacting within the surrounding gas volume. The primary information recorded is the energy loss. We have performed a comparative study of the detector responses using perforated GEM foils, including the 3D electric field maps, to evaluate possible differences in the electronic signals. Preliminary results from this study will be presented and discussed.

#41 – BLANK SPACE