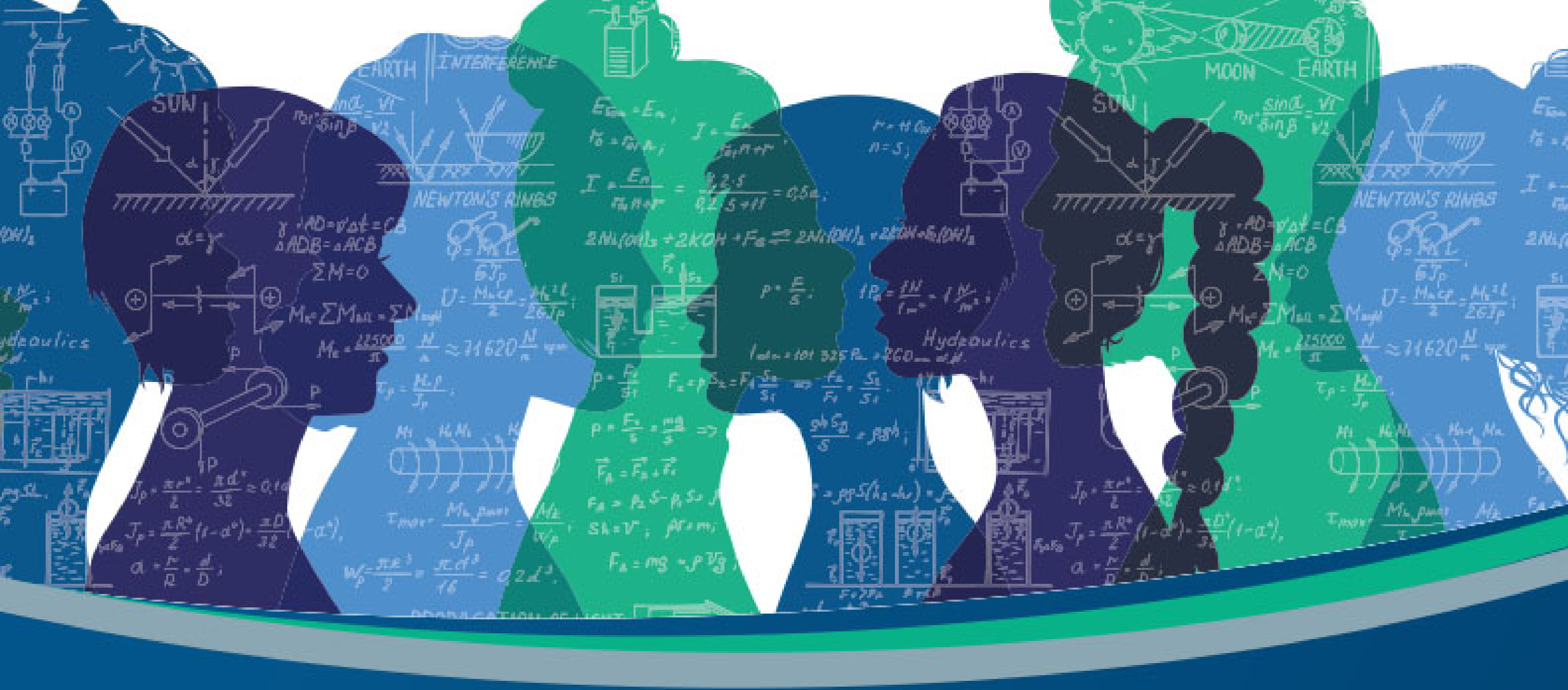

Book of Abstracts

CUWiP 2023

Argonne National Laboratory
Poster Session

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DEPARTMENT OF ENERGY UNITED STATES OF AMERICA

Poster session participantss

P1 – Abigail Gilreath
P2 – Abigail Strack
P3 – Alanna Makarchuk
P4 – Ally Hurd
P5 – Amanda Murphy
P6 – Amanda Ready
P7 – Andrew Valentini and Kaitlyn Prokup
P8 – April Barton
P9 – Bianca Pol
P10 – Catherine La Riviere
P11 – Cielo Medina Medina
P12 – Claire Zwicker
P13 – Elise Kesler
P14 – Grace Smith
P16 – Kassia Schraufnagel
P17 – Kate O'Brien
P18 – Kathryn Grigg
P20 – Maria Fernandez Davila Pastor
P21 – Marianna Rogers
P22 – Naomi Surica Shechter
P23 – Natalie Malagon
P24 – Nicole Kuchta
P25 – Nova Moore
P26 – Sara Sawford
P27 – Xiaolin Rong
P28 – Yifan Zhao

P1: Abigail Gilreath, Linnea Larson, Khadija Hamisi

Characterization of Magnetic Actuation of Biological Systems

The ability to precisely manipulate the motion of micro and nanostructures is essential to biomedical research since well-defined spatial and temporal control is necessary in many applications including separation and isolation of cells, microfluidic devices, medical diagnoses, and drug delivery. In order to quantify the torque applied on a superparamagnetic bead in an external magnetic field, it is essential to know the magnetization of individual beads. This research establishes a novel approach to investigate the field dependent magnetization of individual MyOne Dynabeads for external fields between 10 Oe to 100 Oe which previously published methods were not able to explore. To overcome the challenges of tracking the movement of single beads, the bead is attached to a stiff DNA microrod which are assembled through the DNA origami technique. The DNA microrod is fixed to the surface and to the superparamagnetic bead on the other end. By applying in-plane external fields to the DNA-rod tethered beads, the strength and orientation of the magnetization can be determined from the response and thermal fluctuations of the bead. Preliminary results show that there are two contributing factors to the net magnetic moment: the permanent moment which dominates at lower fields, and the induced anisotropic component which dominates at higher fields. The orientation of the magnetic field can change as the external field is increased when the permanent moment does not lie along the easy axis of the bead. The permanent moment is found to be on the order of 10-17 Am2 which agrees with results published from dimer-based measurements.

Authors: Stephanie Lauback, Linnea Larson, Khadija Hamisi, Abigail Gilreath (Hillsdale College)

P2: Abigail Strack

Polarization Synthesis of Hermite-Gaussian Beams Using a Mach-Zehnder Interferometer

Research was conducted in Dr. Singh's Quantum Optics/Laser Physics Lab. The project's goal was to produce a cylindrically polarized Hermite-Gaussian beam both theoretically and experimentally. For the theoretical portion, density and polarization plots were produced in Mathematica using the Hermite polynomials. The quantum numbers were varied to produce plots for each mode. Experimentally, the cylindrically polarized beam was produced using a Helium-Neon laser and a modified Mach-Zehnder interferometer. The Mach-Zehnder interferometer was first set up to achieve zero-degree alignment after the beam had been split into two paths and superposed back together. To modify the interferometer, a dove prism was inserted into one of the optical paths to reorient one the polarization by 90-degrees. This set-up was able to produce the cylindrically polarized beam. Various modes were tested by adjusting the optical fibers that altered them. This project is significant not only because of its fundamental interest in the studies of polarization, but also because the cylindrically polarized beams, which can be focused tightly, can be applied to optical manipulation of micro- and nanoparticles, microscopy, lithography, and particle accelerators. This research project was funded by the NSF and supported by the University of Arkansas.

Authors: Abigail Strack (Wheaton College, University of Arkansas), Dr. Surendra Singh (University of Arkansas), Dr. Reeta Vyas (University of Arkansas)

P3: Alanna Makarchuk

Exploring Snell's Law and the Refraction of Light

This presentation explores the concept of light traveling through one medium to another with Snell's Law. Using Wolfram Mathematica, this computational essay walks through explanations of Snell's Law, and then provides interactive visual examples of how this is used to create a the "Disappearing Coin" magic trick. It also then goes onto display how the refraction of light into water changes the appearance of the bottom of a cup of water.

Authors: Alanna Makarchuk, Bhubanjyoti Bhattacharya (Lawrence Technological University)

P4: Ally Hurd

Measuring Charge Lifetimes in Organic Solar Cells

Printable and flexible solar panels are promising sources of cheap, large-scale renewable energy. Polymer inks are deposited onto sheets of plastic to form thin layers of carbon-based solar cells. Despite the efficiency of printable manufacturing, there are some limitations to these solar cells. First, toxic halogenated solvents have historically been necessary to dissolve polymers to make ink. Additionally, charges must be separated in the cell for a certain amount of time for the cell to efficiently convert light to energy. Many of these organic solar cells have high rates of charge recombination, which shortens their lifetimes of separation. Here, we use a transient photovoltage (TPV) technique to measure these charge lifetimes in cells made from two different organic solvents. The first solvent is toxic, halogenated dichlorobenzene (DCB), typically used to make organic solar cells. The other is a less toxic, non-halogenated solvent, carbon disulfide (CS2). By varying the processing methods in this way, we find that cells made from CS2 have longer charge lifetimes and higher efficiencies than those made with DCB. This indicates that moving forward, we may be able to decrease the toxicity of organic solar cell manufacturing and simultaneously improve the efficiency of the devices, bringing this powerful method of capturing solar energy to the forefront of sustainable design.

Authors: Alexandra Hurd (Macalester College), Awwad Alotaibi, Acacia Patterson, Obaid Alqahtani, Brian Collins (Washington State University)

P5: Amanda Murphy

Invoking Emotional Investment in the Audience of Scientific Documentary

In today's media about science and technology, communicating scientific relevance to a broad audience beyond the scientific community is increasingly important. Communicating complex science research in an engaging, understandable way proves itself to be challenging. Effective communication requires methods of presentation that appeal to the audience's inclination to emotionally connect with media. In our work, we will present tools to emotionally invest audiences in media such as scientific documentaries. In our lab, we are creating a docuseries Curiosity: The Making of a Scientist. Each film of this series shows the personal and professional life of a scientist and the challenges they faced in their path. To create an emotional link with the person behind the science and with the scientific content, we curate elements of cinematography, animation, and storytelling throughout the film's creation process. The creative team is a diverse group of individuals with both science and art interests. This team serves as a test group to forecast the emotional effects and the scientific understanding received. Each scene and the story building is an entirely collaborative process among this group. Such a work process assists in preventing personal biases and creates a narrative that appeals to a wide audience.We present both the creative process and findings of audience surveys showing that aligning science with the personal stories of the scientists increases audience engagement in and understanding of scientific research. These methods can be applied outside of documentary, allowing scientists to communicate effectively to an attentive audience.

Authors: Amanda Murphy (University of Chicago)

P6: Amanda Ready

New Emissive Probe for Plasma Potential Measurements on the Wisconsin Plasma Physics Laboratory's Big Red Ball

Of critical importance to the Wisconsin Plasma Physics Laboratory (WiPPL) is accurate plasma potential (V p) measurements. We present an emissive probe for use on Big Red Ball (BRB) experiments that has a newly designed probe tip with a much simpler geometry than more traditional emissive probes. We will present a guide on this new tip design, as well as the rest of the probe set up and uses of the probe in our experiment.

Authors: Amanda Ready, J. Olsen, C. B. Forest (University of Wisconsin - Madison, Department of Physics)

P7: Andrew Valentini and Kaitlyn Prokup

Modeling Binary Compact Object Merger Events Detected by the LIGO and Virgo Gravitational Wave Observatories

In this investigation, we model multiple neutron star and black hole merger events detected in the LIO-Virgo Collaboration. We use Kepler's Laws and Newtonian mechanics to model an infalling system of two objects with equal masses. We predict the expected increase in frequency or "chirp" of the infalling binary and compare that to what is found in the LIGO-Virgo database (presented in an adjacent poster). In the initial period during which the Newtonian approximation is valid, we find reasonable agreement between our model and the results from the LIGO-Virgo Collaboration, thus verifying the basic physics of the infall. We also estimate the amount of gravitational wave energy emitted during the entire process. This provides a better understanding of the nature of these merger events and why gravitational waves are emitted by these merging compact objects.

Authors: Andrew Valentini and Kaitlyn Prokup (Carthage College)

P8: April Barton

Nucleosynthesis of 51V in Type Ia Supernova Model

Type Ia Supernovae (SNe-Ia) are known to produce several elements in the iron-peak region via fusion reactions that occur in the explosion. Vanadium (V) is an isotope on the low end of the iron-peak and one of the most abundant transition metals in seawater on earth. The origin of V is entangled with understanding disproportionate enrichments of V in stars at the center of our galaxy as well as enrichments on earth with respect to the solar system. A python-based model of SNe-Ia was analyzed to determine the role of SNe-Ia in the nucleosynthesis of ^{51}V. The model used initial parameters of the incomplete explosive silicon burning (ixSi) layer for single-degenerate SNe-Ia. The simulation contained two phases, a thermonuclear burning Phase from 10^{-18}s to 6s with exponentially decaying temperature, starting at 4.8GK, then a Free Expansion Phase from 6s to 1yr. The changing mass fractions of 158 isotopes were examined throughout both phases. The evolution of ^{51}V, ^{51}Cr and ^{51}Mn during the Free-Expansion phase suggests that the majority of ^{51}V produced from SNe-Ia is not synthesized in the burning phase. Rather it is mostly produced through successive radioactive decays, starting with ^{51}Mn produced during the burning phase. By varying the reaction rates involving ^{51}Mn, the nuclear reactions ^{52}Fe(γ,p)^{51}Mn and ^{50}Cr(p,γ)^{51}Mn, were determined to be significant to the nucleosynthesis of ^{51}Mn during the burning phase, and subsequently to the final abundance of ^{51}V.

Authors: April Barton, Claudio Ugalde (University of Illinois Chicago)

P9: Bianca Pol

Nuclear sensitivity studies of astrophysical r-process models

The intermediary steps of the nuclear rapid neutron capture process, or r-process, take place so far outside nuclear stability that many of the exotic nuclei involved have not been studied experimentally. With the opening of the Facility for Rare Isotope Beams (FRIB), experimental measurements of some of these species are finally within reach. This computational project provides an analytical framework for identifying the few key rare isotopes with the most potential to influence the outcome of the r-process. Using the modular nuclear reaction network Skynet, we perform sensitivity studies on the nuclei involved in the r-process. By varying the half-lives of each significant species involved in the computation, we identify which key nuclides could have the greatest effect on our current understanding of the r-process once its half-life is measured experimentally.

Authors: Bianca Pol (University of Chicago), Hendrik Schatz (Michigan State University), Ashley Francis (Michigan State University), Luke F. Roberts (Los Alamos National Lab)

P10: Catherine La Riviere

Emission Spectroscopy of Encapsulated 2D Perovskite Nanocrystals

Two-dimensional organic-inorganic hybrid perovskites offer a multitude of useful optical properties, particularly their high absorption, and high exciton binding energy. This makes them strong candidates for as materials in new optoelectronic technologies. However, hybrid perovskites are unstable and degrade from exposure to ambient conditions, which limits their long-term effectiveness and thus practical uses. We compared the day-dependent change in photoluminescence of encapsulated and neat lead halide perovskite $(C_4H_9NH_3)_2PbI_4$ nanocrystal films and found that encapsulating perovskite nanocrystals with the van der Waals material hBN decreased the speed of the nanocrystals degradation by over 300%. This is promising for the incorporation of perovskites into practical optoelectronic devices, as it will allow the applications to have a longevity previously not possible with hybrid perovskites.

Authors: Catherine La Riviere (Wellesley College), Prathmesh Deshmukh (CCNY Department of Physics, CUNY - Graduate Center), Sitakant Satpathy, Ravindra Kumar Yadav (CCNY Department of Physics), Vinod Menon (CCNY Department of Physics, CUNY - Graduate Center)

P11: Cielo Medina Medina

Computational Exploration of high energy density Metal Ion Electrode Materials

The current demand for power electronics and electric cars requires extensive exploration of Li-ion materials and similar technologies to meet the crucial factors of cost, safety, lifetime, durability, power density, and energy density in rechargeable batteries. In search for potential battery electrodes, Machine Learning techniques were used to predict average voltages and volume changes on metal ion electrodes, in our previous work. Through Machine Learning methods, various high energy density and small volume cell Li-ion electrodes were found. In this study, Li-ions were replaced with Na-ions to produce Na-ion electrodes in addition to the Li-ion materials. Voltage profiles and volume changes of several Li-ion and Na-ion electrodes were computed using DFT methods that showcase potential novel Li-ion and Na-ion materials for application as battery electrodes.

Authors: Cielo Medina Medina (Central Michigan University), Veronica Barone (Central Michigan University), and Isaiah Moses (Penn State University)

P12: Claire Zwicker

Applying Bayesian statistics to identify binaries within the open cluster NGC 6819

We use a Bayesian statistics software suite called BASE-9 to photometrically identify binary stars within the open cluster NGC 6819. We compile photometry from the Gaia, 2MASS, and Pan-STARRS surveys. Using Gaia kinematics and distances, we identify likely cluster members. We then feed these probable cluster members into BASE-9 to recover the cluster's age, distance, reddening, and metallicity as well as star-by-star masses and mass ratios for probable binaries. We identify binaries as those objects that have a posterior distribution of secondary mass whose median value is $\geqslant 3\sigma$ away from zero. We compare NGC 6819's age, distance, reddening, metallicity and binary fraction derived using BASE-9 to previous literature values, and find good agreement. Importantly, our binary study extends ~5 magnitudes fainter than previous radial-velocity binary surveys, enabling future investigations of binary properties as a function of primary-star mass.

Authors: Claire Zwicker (Illinois Institute of Technology), Aaron M. Geller (Northwestern University), Anna Childs (Northwestern University), Erin Motherway (Embry-Riddle Aeronautical University)

P13: Elise Kesler

Upgrading Image Processing for DESGW Pipeline

Identification of electromagnetic counterparts to gravitational wave events has the potential to solve some of the most pressing challenges cosmology faces today, including the Hubble tension. The DESGW (Dark Energy Survey Gravitational Wave) group seeks to characterize these events, as seen by the LIGO-VIRGO-KAGRA network, through an image processing pipeline. We describe improvements and updates to this pipeline made in preparation for the upcoming March 2023 LIGO observing run. These include parallelization of image processing for separate exposures, automation of the pipeline, and updates to the underlying infrastructure. Rapid processing and identification of these events is vital for EM followups, as it allows more instruments to come in and provide detailed spectroscopic information. The recent improvements to the pipeline have improved the speed and efficiency of image processing, thus increasing the potential information to be gained from upcoming gravitational wave observations.

Authors: Elise Kesler (The University of Michigan), Marcelle Soares-Santos (The University of Michigan), Nora Sherman (The University of Michigan)

P14: Grace Smith

Strong Lensing Model of a Potential Major Merger, SPT-CL J0356-5337 at z=1.03

We present a strong lensing analysis and reconstruct the mass distribution of SPT-CL J0356-5337, a galaxy cluster at redshift z = 1.0359. This cluster was previously modeled by Mahler et al. (2020) using ground based imaging and spectroscopy, and single-band Hubble Space Telescope (HST) imaging. Using new multi-band HST data, we identify four additional lensed galaxies to inform a more well-constrained model using 14 sets of multiple images in 7 separate lensed sources. The three previously-known sources were spectroscopically confirmed by Mahler et al. (2020) at redshifts of z = 2.363, z = 2.364, and z = 3.048. Redshifts of two of the newly-discovered arcs were measured using archival MUSE data, at z = 3.0205 and z = 5.3288. Our model corroborates the conclusion that SPT-CL J0356-5337 is dominated by 2 mass components, and is likely undergoing a merger on the plane of the sky. Our lens model will be used in conjunction with X-ray data from Chandra to study the dynamical state of this system and determine whether it is pre- or post-merger; it will potentially confirm the highest redshift bullet-cluster-like example of a dissociative merger.

Authors: Grace Smith (University of Michigan), Guillaume Mahler (Durham University), Kate Napier, Keren Sharon (University of Michigan), Matthew Bayliss (University of Cincinnati), Maxwell Klein, Nicole Kuchta, Ryan Walker (University of Michigan)

P16: Kassia Schraufnagel

Modal Propellant Gauging-Propellant Refueling and On-Orbit Transfer Operations

This experiment tests the ability of Modal Propellant Gauging technology to find dynamic fill levels of a tank while in microgravity. Modal Propellant Gauging (MPG) technology measures the structural acoustic resonant frequencies of the tank and compares the data to a library of known data to determine the fill level. This experiment is designed to be tested in micro and zero gravity through the help of companies like Zero-G and Blue Origin. In particular, the experiment was prepared and optimized for a flight on a Blue Origin New Shepard flight to test MPG technology in zero gravity.

Authors: Kassia Schraufnagel, Gabriela Carranza, Dalton Callow, Ayushi Chandel, Angelica Cuevas, Alec DiGirolamo, Callie Koenig, Justin Wheeler (Carthage College)

P17: Kate O'Brien

Analysis of Filament Homogeneity in composite Bi-2212 wires

$Bi_2Sr_2CaCu_2O_{8-x}$ (Bi-2212) is a superconductor capable of producing large magnetic fields for advanced magnet systems. However, fluctuations in the size and shape of Bi-2212 filaments in a composite wire can affect processing capability and performance. For this project, a set of twelve green-state densified composite Bi-2212/Ag wires comprised from five different configurations, four diameters, and utilizing three different powder sources were sectioned and imaged at 1mm depth intervals to assess the longitudinal homogeneity of the filaments. Image analysis using ImageJ was used to assess the evolution of the geometric characteristics of filaments in the cross-section, and quantify those changes. When looking transversely, there is reduced circularity and area in the trapezoidal shaped sub-bundles and there also tends to be filament elongation at the corners of each bundle. Sample two has more uniform bundle sizes, but a large coefficient of variation longitudinally. Longitudinally, filament size was shown to vary by a factor of two to four within analyzed cross-sections, and filament geometry variation was correlated to sub-element geometry and position within the sub-element. We also found that larger and more circular filaments are more uniform along the length of the wire and the coefficient of variation is independent of radial location, and the powder source, manufacturing date, diameter, or architecture. This analysis will be helpful to Bi-2212 wire manufacturers as they seek to optimize wire layout and powder characteristics for fabricability and performance uniformity.

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Authors: Kate O'Brien, Evan Coursin, Yuan Xu, and Matthew Jewell (University of Wisconsin - Eau Claire)

P18: Kathryn Grigg

Limitless Epidemic: Heterogeneous Pandemic Models with Graphon Networks

In previous works, the SIRS model has mostly been applied to finite, heterogeneous networks. Due to this, our study examines the behavior, properties, and fixed point of the large population SIS and SIRS models using weakly interacting Markov chains on heterogeneous graphons. Primarily, we will investigate the effect of graphons and resolve the following questions:

- ▶ Do our finite networks converge to the limiting network modeled by graphons?
- ▶ Are there differences in the behavior between heterogeneous and homogeneous networks?
- ▶ What does a stationary point look like for a limiting system in the SIS and SIRS models?

Authors: Christopher Boyette (Elon University), Nathan Essner (University of Minnesota Twin Cities), Kathryn Griggs (DePaul University), Jina H. Kim (Iowa State University), Sarah Tannert-Lerner (Macalester College), Ruoyu Wu (Iowa State University)

P20: Maria Davila Pastor

Building an external cavity diode laser for nondestructive imaging of ultracold molecules

Molecules represent a kind of intellectual fulcrum around which we can leverage a complete understanding of small systems to understand the behavior of more complex systems. Molecules with small numbers of atoms represent the most complex objects whose quantum status we can fully control, and they also represent the building blocks of every other complex body; therefore, they have become a fundamental part of research in many-body systems, quantum information, ultracold chemistry and precision measurements. However, at ambient temperatures, molecules are usually found whizzing through space and constantly colliding with each other which makes it extremely difficult to carefully study them. Scientists have found a way around this with ultracold physics. By cooling molecules down to extremely small temperatures, they have gained the capability of fully controlling the internal degrees of freedom at a level of individual quantum states, which also allows for the chemical reactivity to be monitored. One way to achieve this is by using lasers. In my project, I will be constructing an external cavity diode laser that will potentially be used in absorption and phase-contrast imaging. This laser will have a source of light complemented by an external feedback cavity which will help tune in the frequency of the laser to the required one for the desired imaging purposes.

Authors: Maria Fernandez Davila Pastor (Northwestern University)

P21: Marianna Rogers

Process-Structure-Property Relations in High Volume Fraction Aligned Carbon Nanotube/Polymer Nanocomposites for Aerospace Structure Reinforcement

Ultra-strong and lightweight aligned carbon nanotube (A-CNT) reinforced composites with high CNT volume fractions (>50%) have great potential to reinforce aerospace composites in a way that exceeds the current state-of-the-art carbon fiber laminates. This work discusses an experi- mental process-structure-property study demonstrating how void-free 50 volume percent (vol%) A-CNT bulk nanocomposite laminates (BNLs) are achievable via process refinement involving aerospace-grade bismaleimide (BMI) infusion. Achieving densely-packed (50 vol%) A-CNT re- inforced composites at the bulk scale allows their specific strength and specific modulus to be competitive and comparable to those of other composites with similar reinforcement content (50- 60 vol% fiber content in CFRP and GFRP). Exceeding the mechanical property values of state- of-the-art CFRP and GFRP composites with 50 vol% A-CNT reinforced composites would allow A-CNT/Polymer composites to replace CFRP and GFRP composites in next-generation aero-space structures. All in all, this project continues the groundwork for demonstrating how A-CNT reinforced composites have the potential to become a stronger, more lightweight, and lower-cost material ideal for aerospace structures.

Authors: Marianna Rogers (University of Chicago)

P22: Naomi Surica Shechter

GW Strain Calibration of LIGO Detectors with High Precision and Low Latency

The detection of gravitational waves (GW) has opened a new era of astrophysical observation, allowing scientists to view and analyze previously unseen phenomena. This process hinges upon measuring the strain h = ΔL/L of space over L = 4km long baselines, which change by a differential arm (DARM) length on the order of ΔL = 10^-20 meters when a GW passes. From this information-rich time series, a wealth of astrophysical information may be deduced. In order to produce a reliable estimate of the strain, the Laser Interferometer Gravitational Wave Observatory (LIGO) detectors must be precisely calibrated. Furthermore, the calibration pipeline must produce an associated calibration uncertainty estimate with which to characterize the strain. While uncertainty estimates can currently be produced with low latency, it takes months to investigate the sources of error and verify the quality of calibration. Producing a high precision, low latency uncertainty estimate and a diagnostic monitoring software is therefore crucial for LIGO's fourth observing run (O4), scheduled to begin in March 2023. It is this task that forms the basis of this research project. The uncertainty estimation and monitoring software are to be produced using pyDARM, a Python package which implements the DARM control loop model and is currently under development. The software must reliably output uncertainty estimates and a suite of diagnostic plots on the timescale of an hour. It will actively be of use in O4.

Authors: Naomi Shechter (DePaul University), Dr. Alan Weinstein, Ethan Payne (Caltech)

P23: Natalie Malagon

Searching for the Largest Black Holes in HETDEX with Machine Learning

HETDEX is a spectroscopic survey without pre-selection, with the goal of measuring the early universe expansion rate. Having just released the first catalog, we are searching for the most massive black holes. We use a combination of visual vetting with machine learning algorithms, in particular we focus on using t-SNE as an unsupervised learning technique. Since it is a survey without pre-selection, we don't rely on an imaging catalog to select our sources. The unsupervised learning highlights a region of parameter space where we find large black hole masses without significant contamination from false positives. This selection allows us to measure the volume density of these large black holes without pre-selection. We will present our results and examples of the most massive black holes in the early universe. NM acknowledges support from NSF REU grant AST-1757983 (PI: Jogee) funded by NSF and Department of Defense.

Authors: Natalie Malagon (University of Chicago), Karl Gebhardt, Erin Mentuch Cooper, HETDEX Collaboration (University of Texas, Austin)

P24: Nicole Kuchta

A Gravitational Lensing Model of COOLJ2129+0126: a highly-magnified galaxy at z~5, lensed by a high-redshift galaxy cluster

The high mass of galaxy clusters makes them the most extreme examples of gravitational lensing - a phenomenon described by general relativity in which the spacetime curvature distorts light from background sources. Here, we present the first lensing analysis of COOLJ2129-0126, a strong lensing cluster studied by the COOL-LAMPS Collaboration (ChicagO Optically-selected strong Lenses - Located At the Margins of Public Surveys). Discovered using DECaLS grz imaging, COOLJ2129 was spectroscopically confirmed in August 2020 with the Nordic Optical Telescope. The cluster was found to be exceptional for both its high redshift, z=1.33, and its high mass, as evident by the large radius of the giant arc produced by the cluster at 18". The giant arc observed in this field is just as remarkable as the foreground cluster as it is an extremely bright image of a galaxy at redshift z = 3.29. The lensing model for this galaxy cluster is based on multi-band imaging data from the Hubble Space Telescope and ground-based spectroscopy of the lens and background sources. We use these data to identify 21 constraints, primarily from key features and substructures observed in the lensed image. This lensing model is used for constraining the mass of the galaxy cluster, creating a source plane reconstruction, and finding the magnification values of the field - all parameters that are crucial in characterizing the physical processes within and the structure of both the lensing cluster and the background lensed galaxy.

Authors: Nicole Kuchta , Keren Sharon, Kate Napier (University of Michigan), Gourav Khullar (University of Pittsburgh), Guillaume Mahler (Durham University), Michael Gladders (University of Chicago), Hakon Dahle (University of Oslo), Maxwell Klein, Ryan Walker, Grace Smith (University of Michigan)

P25: Nova Moore

Instability of the Instability Strip: A Study of Pulsating White Dwarfs

This report looks at the study of pulsating white dwarf stars, and the analysis of their interiors using asteroseismology techniques. Pulsating white dwarf stars have been a useful tool in developing asteroseismology techniques over the years, due to their ability to be researched by ground based telescopes. For this proposal, known variable white dwarfs near the instability strip of the HR diagram (graph in which the absolute magnitudes of stars are plotted against their spectral types) were studied and used to construct a model that would allow researchers to determine whether white dwarfs they are observing outside outside of the instability strip are variable stars. Observations were taken at Central Michigan University's campus telescope (the Brook's Astronomical Observatory) with additional observations from remote robotic telescopes in Chile. Light curves were then produced from these observations by processing observational data with AstroImageJ to do data reduction and aperture photometry, and then processed using Period04 to take calibrated data and do a discrete Fourier transform on the light curve to find frequencies the star is pulsating at. If observational data suggests stars are pulsating white dwarfs, and they live outside of the instability strip, this suggests that the current instability strip needs to be reevaluated. This study anticipates that some pulsating white dwarf stars live outside of the instability strip, as suggested by research done by Dr. Judith Provencal from the University of Delaware and collaborators. By continuing this research, it can potentially have the astronomical community recognize the need to redefine the instability strip on the HR diagram. There is further potential impact to communities of astronomers that do asteroseismology research. While asteroseismology is being used more frequently in research, it is still a new field of study. This project could help mature and refine the field which impacts the ability of asteroseismologists to get time in observational research facilities (allowing them to get higher consideration when applying to observe through the James Webb Telescope or the Hubble Telescope).

Authors: Nova Moore (Central Michigan University), Advised by Aaron LaCluyzé (Central Michigan University)

P26: Sara Sawford

Dependence of the Top-Quark Mass on the Parton Distribution Functions at Hadron Colliders

The dependence of the top-quark mass measurement on Parton Distribution Functions (PDFs) is explored through the distribution of the invariant mass of the top-antitop system in top-quark pair production at different proton-proton colliders: 8 TeV, 13 TeV, 13.6 TeV, 14 TeV, and 100 TeV. The top-quark mass is obtained from a chi-squared fit to the invariant mass of the top-antitop-quark pair. PDF uncertainties are used in the chi-squared evaluation and are reduced through a fit to rapidity and longitudinal momentum distributions.

Authors: Sara Sawford, Jason Gombas, Jarrett Fein, Reinhard Schwienhorst (Michigan State University)

P27: Xiaolin Rong

1-BUTANOL slows rbl-2h3 cell growth through Reducing cells IN s-phase of THE cell cycle

N-alcohols are model general anesthetics. Past work showed that these hydrophobic molecules partition into membranes and alter miscibility transition temperatures.1 Past work have also found that factors that impacted Rat Basophilic Leukemia (RBL-2H3) cell growth, such as serum starvation or cell density, also impacted miscibility transition temperatures of vesicles isolated from cells.2 In this poster, I will present results on my findings on how n-alcohols modulate cell growth. Preliminary measurements found that cell counts of RBL-2H3 cells are lower after a 24h incubation with 1-Butanol and greater after a 24h incubation with 1-Hexadecanol. To explore further, I employed a flow cytometry assay of the cell cycle using an EdU-Click reagent that incorporates into S-phase cells and DAPI stain that labels all DNA, allowing for the differentiation of a population of cells into their cell cycle phase. Using this assay, I found a dose dependent increase in cells in G0/G1 phases of the cell cycle after treatment with n-Butanol, without impact on cell size. Ongoing work includes exploring the impact of other n-alcohols such as 1-Hexadecanol, and possible causes for slow-down of cells through the G1 checkpoint.

Authors: Xiaolin Rong, Dr. Sarah Veatch (University of Michigan)

P28: Yifan Zhao

Domain Adaptation for Strong Gravitational Lens Classification

Using supervised deep learning methods to understand cosmological survey data has become increasingly important. We adopt such methods for strong gravitational lens data. In particular, we examine the effect of domain adaptation on the classification of gravitational lenses in simulated images. Though the classification of strong lenses with simulated data has been studied, no work has been done with domain adaptation. We evaluated two domain adaptation techniques - domain adversarial neural networks (DANN) and maximum mean discrepancy (MMD). We simulated simple galaxy-galaxy strong gravitational lens images using the deeplenstronomy package to create source data and added Poisson noise on top to make target data. We then train with a convolutional neural network (CNN), obtaining classification test accuracies of near 100% and 50% on the source and target data, respectively. When training with MMD, the classification test on the target data increases to 60% while maintaining high source accuracy. With DANN, a target accuracy of 98-99% can be consistently achieved, while maintaining a source accuracy of >99%. While the dataset is highly simplified, the results demonstrate potential for further application of these techniques on gravitational lens classification problems with real survey data. We are also transitioning to a regression analysis where specific parameters from the dataset will be inferred.

Authors: Yifan Zhao (University of Chicago), Paxson Swierc (University of Chicago), Brian Nord (Fermilab), Aleksandra Ćiprijanović (Fermilab)