CUWiP 2023 @ Princeton/PPPL

Report of Contributions

Contribution ID: **1** Type: **not specified**

Plenary Talk

Friday, 20 January 2023 19:30 (1 hour)

Presenter: Dr PRESCOD-WEINSTEIN, Chanda (University of New Hampshire)

Contribution ID: **2** Type: **not specified**

Opening Remarks

Friday, 20 January 2023 18:00 (30 minutes)

Presenters: VERLINDE, Herman (Princeton University); SWILLEY-GRECO, Shannon (PPPL); Prof. COWLEY, Steve (PPPL)

Contribution ID: **3** Type: **not specified**

Opening Remarks

Saturday, 21 January 2023 08:30 (15 minutes)

Presenter: SWILLEY-GRECO, Shannon (PPPL)

Contribution ID: **4** Type: **not specified**

Plenary Talk

Saturday, 21 January 2023 08:45 (45 minutes)

Presenter: Prof. VEATCH, Sarah (University of Michigan)

Contribution ID: **5** Type: **not specified**

Career Panel

Saturday, 21 January 2023 11:15 (45 minutes)

Presenters: TOLIVER, Brandi (DOE); KNUTSON, Erin (APS); HERNANDEZ, Kayla (Brookhaven National Laboratory); GREGORY, Samantha (United States Military Academy); DOBBINS, Tabbetha (Rowan University)

Contribution ID: **6** Type: **not specified**

Keynote Address

Saturday, 21 January 2023 14:00 (1h 30m)

Presenter: Prof. MASON, Nadya (UIUC)

Contribution ID: **8** Type: **not specified**

Morning Announcements

Sunday, 22 January 2023 08:30 (15 minutes)

Presenter: SWILLEY-GRECO, Shannon (PPPL)

Contribution ID: **9** Type: **not specified**

Plenary Talk

Sunday, 22 January 2023 08:45 (45 minutes)

Presenter: Dr ESQUIVEL, Jessica (FermiLab)

Contribution ID: **10** Type: **not specified**

Closing Remarks

Sunday, 22 January 2023 11:30 (30 minutes)

Presenter: SWILLEY-GRECO, Shannon (PPPL)

Contribution ID: **11** Type: **not specified**

LGBTQ+ Allyship and Inclusion

Saturday, 21 January 2023 09:45 (1 hour)

Presenter: LIN, Loki

Session Classification: Workshops

Contribution ID: **12** Type: **not specified**

Science Communication

Saturday, 21 January 2023 09:45 (1 hour)

When people say "science is hard," they might feel like they can't understand it — that it's all over their head. I disagree! I think most everyone is smart enough to "get" the way the world works. Usually, they're just missing definitions (scientists' shorthand is a lot to learn) and confidence that their intuition is enough for the task (it is!). In this interactive workshop on science communication, we'll talk about relating to your audience, breaking down topics to build them back up, the fallacy of the well-read baby, and how to get scientists to come around. The more you remember knowing nothing, the better!

Presenter: KRAUS, Frances (PPPL)

Session Classification: Workshops

Contribution ID: **13** Type: **not specified**

Communication and Negotiation Skills

Saturday, 21 January 2023 09:45 (1 hour)

The seminar will focus on professional skills that women need to effectively perform research and thrive in physics, including how to:

- Negotiate a graduate, postdoc, or professional position in academia, industry, or at a national lab
- Interact positively on teams and with a mentor or advisor
- Think tactically
- Enhance personal presence
- Develop alliances
- Achieve professional goals

More information is available on the APS website.

Presenter: HUGHES, Roxanne (MagLab)

Session Classification: Workshops

Contribution ID: **14** Type: **not specified**

Advocacy to Bring About Cultural Change

Saturday, 21 January 2023 09:45 (1 hour)

What does it mean to be an advocate? Advocacy today is bigger than form emails, stuffy suits traipsing down the halls of Congress, and the same tired song and dance with legislative offices. Advocacy is showing up as your authentic self, engaging leaders with energy and passion, and building strong coalitions that can go the distance. How can you be seen, heard, and taken seriously without losing your internal compass or cutting out parts of what makes you who you are? From advocating for yourself to advocating for issues, we'll explore the fundamental principles of advocacy that we can incorporate into our own lives. In this session, we will dive into the power of storytelling, tapping into your authentic self, and how to establish yourself as a leader in your community.

Presenter: PRUETT, Callie (Appalachians for Appalachia)

Session Classification: Workshops

Contribution ID: **15** Type: **not specified**

Mental Health

Saturday, 21 January 2023 09:45 (1 hour)

Presenters: PASTOR, Allison; WELSH, Andrea (University of Pittsburgh)

Session Classification: Workshops

Contribution ID: **16** Type: **not specified**

Applying to Graduate School

Saturday, 21 January 2023 09:45 (1 hour)

Owning your graduate school experience: Building your success toolkit from application to graduation

Via this workshop participants will gather tools to help them navigate aspects of exploring, applying, and selecting graduate programs. More importantly, it will help participants build their own toolkit for effective communication, self-advocacy, and leadership development. This presentation will offer the perspective of an Academic Diversity Officer, scientist and mentor.

Presenter: GONZALEZ-PEREZ, Vanessa (University of Pennsylvania)

Session Classification: Workshops

Contribution ID: **17** Type: **not specified**

Getting Involved in Undergraduate Research

Saturday, 21 January 2023 09:45 (1 hour)

Presenters: TRUHLAR, Allison (DOE); TOLIVER, Brandi (DOE); BISSONETTE, Daisy (Princeton University); GUEYE, Diakhère (IAEA); KOLLMANN, Kassidy (Princeton University); MALOOF POUSSART, Pascale (Princeton University)

Session Classification: Workshops

Contribution ID: **18** Type: **not specified**

Astrophysics

Saturday, 21 January 2023 09:45 (1 hour)

9:45 - 10:15: Jo Dunkley, “The Earliest Image of the Universe”

I will talk about my work analyzing the cosmic microwave background, which is the earliest image we have of the universe. I use telescopes in Chile to study this exciting signal, that tells us about fundamental properties of the universe like its age, composition, and how fast it is growing. We also hope that it will reveal new information about the ‘invisible’ universe, and the very first moments of its expansion. I will also talk a bit about my own career path and some of the things I do beyond research.

10:15 - 10:45: Jenny Greene, “Looking for the first massive black holes with the James Webb Space Telescope”

Presenters: GREENE, Jenny (Princeton University); DUNKLEY, Jo (Princeton University)

Session Classification: Workshops

Contribution ID: **19** Type: **not specified**

Science Talk

Presenter: GREENE, Jenny (Princeton University)

Session Classification: Workshops

Contribution ID: **20** Type: **not specified**

Science Talk

Presenter: LEVINESS, Alex (PPPL)

Session Classification: Workshops

Contribution ID: **21** Type: **not specified**

Plasma Physics

Saturday, 21 January 2023 09:45 (1 hour)

9:45 - 10:15: Alex Leviness, “What’s a Stellarator?”

A stellarator is a type of device that magnetically confines a plasma so that nuclear fusion can occur. After the tokamak, it is the second most popular option for a fusion reactor design, and the past several decades have seen major advances in the design and construction of these devices. I will cover some basics of fusion, the advantages and challenges of the stellarator, and my own experience doing research on the largest stellarator in the world, Wendelstein 7-X.

10:15 - 10:45: Fatima Ebrahimi, “A Solar-flare Rocket”

A new type of rocket engine propels a spacecraft by taking advantage of the physical mechanism that accelerates solar flares, so-called magnetic reconnection. The engine applies magnetic fields to force particles of electrically charged gas, or plasma, to shoot out the back of a rocket with high velocity, causing forward momentum. I will present some basics of the magnetic reconnection process and how this type of rocket engine was inspired by my research in fusion energy.

Presenters: LEVINESS, Alex (PPPL); EBRAHIMI, Fatima (PPPL)

Session Classification: Workshops

Contribution ID: **22** Type: **not specified**

APS Communication and Negotiation Skills Seminar

Saturday, 21 January 2023 12:45 (1 hour)

The seminar will focus on professional skills that women need to effectively perform research and thrive in physics, including how to:

- Negotiate a graduate, postdoc, or professional position in academia, industry, or at a national lab
- Interact positively on teams and with a mentor or advisor
- Think tactically
- Enhance personal presence
- Develop alliances
- Achieve professional goals

More information is available on the APS website.

Presenter: HUGHES, Roxanne (MagLab)

Session Classification: Workshops

Contribution ID: **24** Type: **not specified**

LGBTQ+ Allyship and Inclusion

Saturday, 21 January 2023 12:45 (1 hour)

Presenter: LIN, Loki

Session Classification: Workshops

Contribution ID: **25** Type: **not specified**

Science Communication

Saturday, 21 January 2023 12:45 (1 hour)

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Presenter: KRAUS, Frances (PPPL)

Session Classification: Workshops

Contribution ID: **26** Type: **not specified**

Advocacy to Bring About Cultural Change

Saturday, 21 January 2023 12:45 (1 hour)

What does it mean to be an advocate? Advocacy today is bigger than form emails, stuffy suits traipsing down the halls of Congress, and the same tired song and dance with legislative offices. Advocacy is showing up as your authentic self, engaging leaders with energy and passion, and building strong coalitions that can go the distance. How can you be seen, heard, and taken seriously without losing your internal compass or cutting out parts of what makes you who you are? From advocating for yourself to advocating for issues, we'll explore the fundamental principles of advocacy that we can incorporate into our own lives. In this session, we will dive into the power of storytelling, tapping into your authentic self, and how to establish yourself as a leader in your community.

Presenter: PRUETT, Callie (Appalachians for Appalachia)

Session Classification: Workshops

Contribution ID: **27** Type: **not specified**

Mental Health

Saturday, 21 January 2023 12:45 (1 hour)

Presenters: PASTOR, Allison; WELSH, Andrea (University of Pittsburgh)

Session Classification: Workshops

Contribution ID: **28** Type: **not specified**

Applying to Graduate School

Saturday, 21 January 2023 12:45 (1 hour)

Owning your graduate school experience: Building your success toolkit from application to graduation

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Presenter: GONZALEZ-PEREZ, Vanessa (University of Pennsylvania)

Session Classification: Workshops

Contribution ID: **29** Type: **not specified**

Learning the Language of Light: My Journal from Physics Undergrad to Materials Science Grad to Physics Professor and Beyond

Saturday, 21 January 2023 12:45 (1 hour)

This talk describes my own career trajectory with a message to encourage students to understand how their own journey from undergrad/grad school toward their goals can be made even more intentional. It covers learning styles and approaches, narratives/story telling principles, and understanding their own personal motivators. I hope this talk encourages students to map out their journey and be prepared to understand and enjoy the detours along the way.

Presenter: DOBBINS, Tabbetha (Rowan University)

Session Classification: Workshops

Contribution ID: **30** Type: **not specified**

Biophysics

Saturday, 21 January 2023 12:45 (1 hour)

Biophysics, broadly, is interested in taking the rules and laws we know from physics and using them to help quantify and explain behaviors we observe in biological systems. This can be anything from studying social behaviors and postures in animals, to modeling the response of the immune system to disease, to using microscopy and optics to examine tiny details in a cell. In this session, we will talk about some ongoing biophysics studies from both an experimental and theoretical perspective.

Presenters: HOLMES, Caroline (Princeton University); HALLINEN, Kelsey (Princeton University)

Session Classification: Workshops

Contribution ID: **32** Type: **not specified**

Science Talks

Sunday, 22 January 2023 10:00 (1 hour)

1 - 1:30: Claire Gmachl, "Quantum Cascade Ring Lasers and Related Systems"

Monolithic integrated photonics is a large field of active research interests, both foundational and for applications as varied as sensing or computing. Our interests in this area are especially directed towards active integrated photonics, where the light-guiding waveguides are at the same time functioning as light sources – lasers and spontaneous emitters – or detectors. Furthermore, we are focusing on the mid-infrared spectral range. We have designed and fabricated monolithic, $\lambda \sim 8\mu\mathrm{m}$ quantum cascade ring lasers evanescently coupled either to linear waveguides for light coupling or to a second ring laser. For the lasers coupled to waveguides, injection of spontaneous emission from the coupled waveguide arms selects the clockwise or counter-clockwise mode with great fidelity. Without such injection the uniform ring laser shows bi-stability between the two rotational modes. Lasers coupled to another ring laser show complex rotational mode selection behavior not explained by straightforward mode-coupling. Besides mid-infrared, active, integrated photonics, recent research also explores the potential of applications of machine learning to quantum cascade laser design.

Delilah Gates, 1:30 - 2, "Red Light, Blue Light: Emission from Sources Orbiting Spinning Black Holes"

Black holes provide the strongest gravity environments in our universe. While the region the region of spacetime near the event horizon is at large gravitational redshift relative to distant observers, matter orbiting in this region travels at relativistic speeds and can impart a significant Doppler shift to its electromagnetic emission. Hence emission from sources near a black hole can be observed with a net redshift or blueshift. Here we discuss features of photon emission from circular equatorial orbiters around black holes which help provide constraints on the black hole spin and inclination.

Presenters: GMACHL, Claire (Princeton University); GATES, Delilah (Princeton University)

Session Classification: Workshops

Contribution ID: **33** Type: **not specified**

Science Talk

Presenter: GMACHL, Claire (Princeton University)

Session Classification: Workshops

Contribution ID: **34** Type: **not specified**

LGBTQ+ Allyship and Inclusion

Sunday, 22 January 2023 10:00 (1 hour)

Presenter: LIN, Loki

Session Classification: Workshops

Contribution ID: **35** Type: **not specified**

Science Communication

Sunday, 22 January 2023 10:00 (1 hour)

When people say "science is hard," they might feel like they can't understand it — that it's all over their head. I disagree! I think most everyone is smart enough to "get" the way the world works. Usually, they're just missing definitions (scientists' shorthand is a lot to learn) and confidence that their intuition is enough for the task (it is!). In this interactive workshop on science communication, we'll talk about relating to your audience, breaking down topics to build them back up, the fallacy of the well-read baby, and how to get scientists to come around. The more you remember knowing nothing, the better!

Presenter: KRAUS, Frances (PPPL)

Session Classification: Workshops

Contribution ID: **36** Type: **not specified**

Advocacy to Bring About Cultural Change

Sunday, 22 January 2023 10:00 (1 hour)

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Presenter: PRUETT, Callie (Politicary)

Session Classification: Workshops

Contribution ID: **37** Type: **not specified**

Mental Health

Sunday, 22 January 2023 10:00 (1 hour)

Presenter: WELSH, Andrea (University of Pittsburgh)

Session Classification: Workshops

Contribution ID: **38** Type: **not specified**

Applying to Graduate School

Sunday, 22 January 2023 10:00 (1 hour)

Owning your graduate school experience: Building your success toolkit from application to graduation

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Presenter: FLOWERS, Erin (Princeton University)

Session Classification: Workshops

Contribution ID: **39** Type: **not specified**

Getting Involved in Undergraduate Research

Sunday, 22 January 2023 10:00 (1 hour)

Presenters: TRUHLAR, Allison (DOE); TOLIVER, Brandi (DOE); BISSONETTE, Daisy (Princeton University); GUEYE, Diakhère (IAEA); KOLLMANN, Kassidy (Princeton University); MALOOF POUSSART, Pascale (Princeton University)

Session Classification: Workshops

Contribution ID: **41** Type: **not specified**

First-Generation and Low-Income Students in Physics

Presenter: SHAW, Ashlee (Princeton University)

Session Classification: Workshops

Contribution ID: **43** Type: **not specified**

First-Generation and Low-Income Students in Physics

Saturday, 21 January 2023 12:45 (1 hour)

Presenter: SHAW, Ashlee (Princeton University)

Session Classification: Workshops

Contribution ID: **44** Type: **not specified**

A Dual QSO at Cosmic Noon

Saturday, 21 January 2023 16:30 (1h 30m)

We report the discovery of a candidate dual QSO at at z=1.889, a redshift that is in the era known as “cosmic noon” where most of the Universe’s black hole and stellar mass growth occurred. The source was identified in Hubble Space Telescope WFC3/IR images of a dust-reddened quasar that showed two closely-separated point sources at a projected distance of 0. 26, or ~ 2 kpc. This red quasar was targeted for imaging to test the hypothesis that red quasars are hosted by merging galaxies. We subsequently obtained a spatially-resolved STIS spectrum of the system, covering the visible spectral range, verifying the presence of two distinct quasar components. The sources have similar black hole masses, bolometric luminosities, and radio loudness parameters. However, their colors and reddenings differ significantly. The redder quasar has a higher Eddington ratio, consistent with previous findings. We continue to test this system as a bona-fide dual QSO, which links dust-reddening to galaxy and black hole mergers, opening up a new population in which to search for samples of dual AGN.

Presenter: LANGGIN, Rachel (Bryn Mawr College)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **45** Type: **not specified**

Radio Astronomy: The Baryonic Tully Fisher Relation for Galaxies with Supernova Distances

Saturday, 21 January 2023 16:30 (1h 30m)

We cannot measure things in space directly. Instead, we rely on mathematical relations to manipulate the limited data we can collect. The Baryonic Tully-Fisher Relation is one such relation. This equation says that the baryonic mass of a spiral galaxy is related to its rotational velocity. Unfortunately, the current data supporting the Baryonic Tully Fisher Relation has a lot of scatter. As a result, we are uncertain of the extent of its accuracy. This past summer I worked with the Undergraduate Arecibo Legacy Fast ALFA research team. We are trying to reduce this scatter by observing hydrogen emissions from spiral supernova host galaxies. Supernovae are standard candles, which means that they have a known absolute brightness. Due to this, measurements of the emissions from these galaxies will be extremely precise. This precision hopefully will reduce the scatter. Once this is done, the accuracy of the Baryonic Tully Fisher Relation will be more obvious, and the decision can be made as to whether any revisions should be made to this relation.

Presenter: MCSWAIN, Georgia (Washington and Lee University)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **46** Type: **not specified**

Finding EMRI Gravitational Wave Signals in Simulated LISA Data

Saturday, 21 January 2023 16:30 (1h 30m)

In preparation for the upcoming Laser Interferometer Space Antenna (LISA) mission, the LISA Data Challenges pose a series of open questions on how to extract gravitational wave (GW) signals from simulated LISA data. Solving these challenges is essential to demonstrating effective analysis methods for the mission in the mid-2030s. As the LISA mission will detect GW signals in a new frequency range, a variety of previously undetected GW source types will be present in the LISA data. One such source type is the extreme mass-ratio inspiral (EMRI), an inspiraling binary system where a stellar mass object orbits a supermassive black hole. This project seeks to use Markov Chain Monte Carlo (MCMC) algorithms to develop reliable methods for identifying EMRI signals and extracting their source parameters.

Presenter: MULLER, August (Haverford College)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **47** Type: **not specified**

Star Formation Efficiency in Superthin Galaxies

Saturday, 21 January 2023 16:30 (1h 30m)

Superthin galaxies are spiral galaxies that exhibit large axial ratios (>10) with no distinguishable bulge component. The sixth data release of the Sloan Digital Sky Survey showed approximately 15% of the observed edge-on disk galaxies to be bulgeless. Simulations have struggled to replicate this result in the context of the hierarchical and Lambda-CDM models since the superthin galaxies would have to be relatively undisturbed by mergers. One proposed explanation is that superthin galaxies have compact dark matter halos that help stabilize their discs. Observations have shown that superthin galaxies have maintained their gas and low surface brightness stellar discs for a Hubble time, despite predictions of instability in the discs that would result in high star formation efficiencies. Using the first CO(1-0) ALMA observations of a sample of superthin galaxies, our work established the star formation efficiency of each galaxy from their star formation rates and mass of hydrogen gas. Our analysis of the first ten target galaxies shows they have self-similar profiles. We also found that these galaxies have longer depletion times and lower star formation efficiencies than typical spiral galaxies. Low star formation efficiencies support the theory of compact dark matter halos, as the added stability from a halo would increase the disk stability parameter. Future dynamic modeling of these galaxies using these ALMA observations will further constrain their dark matter distribution.

Presenter: BISSONETTE, Daisy (Princeton University)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **49** Type: **not specified**

Are Brightest Cluster Galaxies Special?

Saturday, 21 January 2023 16:30 (1h 30m)

A longstanding question when studying Brightest Cluster Galaxies (BCGs) and their evolution is whether their luminosities are statistical extremes of the luminosity distribution of other cluster member galaxies, or whether their luminosities follow a different,"special" distribution. To explore this question, we use the two Tremaine-Richstone (1977;TR) statistics that sometimes lead to different conclusions about BCG specialness. We run Monte Carlo simulations of galaxy clusters with varying galaxy luminosity functions and BCG properties, and explore the sensitivity of the TR statistics to the adjusted BCG properties. We identify cases where the two statistics lead to different conclusions. The first of the Tremaine-Richstone statistics, which relies on the spread of BCG masses, is more reliable to specialness than the second, which utilizes the spread in the mass gap between the BCG and second ranked galaxy.

Presenter: POBRE, Savannah (Princeton University)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **50** Type: **not specified**

The Stellar Mass Fractions of Clusters of Galaxies

Saturday, 21 January 2023 16:30 (1h 30m)

We determine the total stellar mass fraction (stellar mass/total mass) in clusters of galaxies using data from the Dark Energy Survey for ~ 300 clusters in the redshift range 0.2-0.3 (Zhang et al. 2019). We use the total observed luminosity of the clusters, including their Brightest Cluster Galaxy (BCG), satellite galaxies, and Intracluster Light (ICL). Previous studies claimed that clusters are inefficient in star formation when investigating the stellar light in the BCG relative to the total cluster mass; the stellar mass of the BCG relative to the total cluster mass drops sharply with increasing cluster mass. Here we find that when the total stellar mass in clusters is included, as obtained from the total cluster luminosity, clusters are not inefficient in star formation. In fact, we find that clusters are as efficient in star formation as expected from the sum of their individual cluster members. We find the total stellar mass fraction in rich clusters to be ~1.5% ± 0.6%, exactly as expected from the sum of the luminosity function of cluster members, which have stellar mass fractions that range from ~3% for bright L* galaxies to very low stellar mass fractions for fainter galaxies. The BGCs simply do not grow their stellar light as fast as clusters grow their mass. This is indeed expected since merging clusters grow their mass continuously, while BCGs merge and grow only occasionally. Finally, we find that the total stellar mass traces the total mass of clusters well. This can potentially offer a new tracer of total cluster mass.

Presenter: GOUNTANIS, Nicole (Princeton University)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **51** Type: **not specified**

Preliminary Faraday Rotation Results Associated with the Photoionized Gas of IC 1396

Saturday, 21 January 2023 16:30 (1h 30m)

We present initial Faraday rotation measurements of extragalactic radio sources with lines of sight passing through or near to the HII region of IC 1396. We measured the linear polarization of the sources with the Karl G. Jansky Very Large Array (VLA) at frequencies of ~5 GHz (6 cm) . We estimate the background rotation measure (RM) in this region of the galaxy to be ~ -140 m^-2. We find the sources having lines of sight passing through IC 1396 have an excess rotation measure of |RM| ~ 62-465 rad m^-2 with respect to the background. We will discuss rotation measure values in the context of magnetized plasma of IC 1396. We compare our results to known models of rotation measure in our galaxy.

Presenter: RAHMAN, Ramisa (William & Mary)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **52** Type: **not specified**

Cold Quasar Investigation: Comparing Central Star Formation Rates to Black Hole Growth

Saturday, 21 January 2023 16:30 (1h 30m)

A new population of quasars–titled cold quasars–has been discovered that are associated with host galaxies that have a high star formation rate. We aimed to study the host galaxies of 65 of these cold quasars in order to further evaluate their peculiar characteristics. Data was collected from the XMM-XXL survey and cross-matched with the VHS, WISE, and HerMES surveys to obtain multiwavelength data. From the data, we calculated the supermassive black hole's mass using broad emission from the MgII and Hbeta lines. We compared this with the stellar mass of the entire galaxy and find that the black holes are overmassive compared with local relations, indicating that the black hole grows first in entirety before the stellar mass is in place. In addition to this, we created a spectral energy distribution for each galaxy to calculate the star formation rate. We compared the star formation rate with the black hole accretion rate and find that the stellar mass is rapidly increasing at a relative rate faster than the black hole growth, supporting the picture where the black hole grows first.

Presenter: MINTZ, Sasha (Virginia Tech)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **53** Type: **not specified**

Cosmological constraints on atomic dark matter

Saturday, 21 January 2023 16:30 (1h 30m)

An atomic dark matter model, consisting of self-interacting “dark protons,” “dark electrons,” and “dark photons,” as explored by Cyr-Racine and Sigurdson (2013), is observationally viable, provides new observational signatures beyond non-interacting cold dark matter, and might provide a solution to the Hubble tension and the σ_8 tension. We present updates to constraints on the model from cosmic microwave background (CMB) and baryon acoustic oscillation (BAO) data, both with and without Cepheid-calibrated supernovae constraints on the Hubble constant. We set limits, in these two scenarios, on the fraction of dark matter that could be atomic dark matter. We also find that lower values of σ_8 are allowed with lower dark photon temperature in both scenarios.

Presenter: HUGHES, Ellie (Bryn Mawr College)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **54** Type: **not specified**

Deposition of Pt/Co/Ir multilayer films with interfacial Dzyaloshinskii-Moriya interactions

Saturday, 21 January 2023 16:30 (1h 30m)

Multilayered thin films with interfacial Dzyaloshinskii-Moriya interactions (iDMI) can enable the formation of stable magnetic skyrmions at room temperature, which have potential for storage, logic, and neuromorphic computing applications [1-5]. Understanding of iDMI is key to designing optimized multilayer structure for device applications. Here we report deposition of Pt/Co/Ir multilayer films with perpendicular magnetic anisotropy (PMA) for investigating iDMI by Brillouin light scattering (BLS). We deposited Pt(1.5nm)/Co(1.0nm)/Ir(1.0nm) trilayer thin films with a Ta buffer layer and SiO2 capping layer on thermally oxidized Si wafer by DC magnetron sputtering with deposition rates for each layer previously calibrated by small angle x-ray reflectivity. Comparison of magnetic hysteresis loops obtained with in-plane and out-of-plane magnetic fields confirmed PMA in the deposited Pt/Co/Ir multilayer films. We have used BLS to quantify the iDMI in the deposited Pt/Co/Ir multilayers through measurement of the frequencies of counterpropagating surface spin waves as a function of the wavevector, and we find that the additional Ir layer leads to measurable changes in the iDMI as compared to [Pt/Co] bilayers.
Ref:
[1] A. Fert, V. Cros, J. Sampaio, Nat. Nanotechnol. 8 (2013) 152.
[2] X. Wang et al., Phys. Rev. Materials 6 (2022), 084412.
[3] W. Jiang, et al., Phys. Rev. B 99 (2019), 104402.
[4] C. Moreau-Luchaire, et al., Nat. Nanotechnol. 11 (2016) 444.
[5] A.T. Clark et al., JMMM 563 (2022), 169951.

Presenter: ZHANG, Yuqi (Bryn Mawr College)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **55** Type: **not specified**

Stochastic modeling of sRNA-mRNA sequestration and reduction of translational burst noise in Vibrio quorum-sensing networks

Saturday, 21 January 2023 16:30 (1h 30m)

Interactions between biomolecules in DNA replication, transcription, and translation possess inherent stochasticity, which leads to intrinsic noise in gene expression (Elowitz et al., 2002). Organisms deploy various methods for regulating this noise to maintain precise RNA and protein levels. In Vibrio quorum-sensing networks, small, regulatory RNAs (sRNAs) called Qrr (Quorum regulatory RNA) regulate protein production by a sequestration mechanism in which luxO mRNA and a Qrr form a complex, sequestering the luxO mRNA ribosome-binding site and thus repressing translation (Feng et al., 2015). Previous mathematical models indicate that accelerated catalytic degradation of mRNAs by sRNAs can reduce protein noise in both prokaryotes (Levine et al., 2007, Mehta et al., 2008) and eukaryotes (Schmiedel et al., 2015). However, those models do not consider how the inhibition of translation by mRNA sequestration affects intrinsic noise in protein expression. Here, we extend existing models to address the sRNA-mRNA sequestration mechanism in bacterial regulatory networks. Like mRNA degradation, reversible sequestration of mRNA shortens the free-mRNA correlation time, reducing variation in resulting levels of translated protein, but without degrading the mRNA. By simulating this reaction network using the Gillespie stochastic simulation algorithm (SSA), we show that sequestration can dramatically reduce translational burst noise. At high sRNA levels, protein noise is reduced to the Poisson limit. We also demonstrate the existence of multiple distinct regimes of noise reduction depending on model parameters, revealing that protein noise reduction by mRNA sequestration is much more complex than previously thought. Our findings open avenues for further exploration into the feasibility of noise reduction by mRNA sequestration, with implications for microRNA-based noise regulation in eukaryotes.

This research was made possible by the generous support of the Lewis-Sigler Institute for Integrative Genomics.

Presenter: LIU, Meryl (Princeton University)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **56** Type: **not specified**

Effects of X-Ray Exposure on Physical Characteristics of Metallic Thin Films

Saturday, 21 January 2023 16:30 (1h 30m)

"Effects of X-ray Exposure on Physical Characteristics of Metallic Thin Films"
Dorothy Doughty & Dr. Jeffery Hettinger

This experiment is designed to understand the impacts of broad spectrum radiation on metallic films with emphasis on corrosion resistance. There was an analysis of depositions of films on a silicon substrate: Copper, Titanium, Titanium Nitride, Silver, and Aluminum. These deposition samples were analyzed through Scanning Electron Microscope and Energy Dispersive X-ray Spectroscopy then irradiated through a rhodium x-ray source. These atomic compositions of these samples were compared before and after x-ray exposure and determined to have an increase in oxygen composition after x-ray exposure. These x-rayed films underwent a series of acid etching tests and the x-rayed samples had an increased resistivity to corrosion. The resistivity was visual in decreased pitting in the x-rayed films. The composition of the oxide layer was analyzed through the Scanning Electron Microscope and the oxide layer was visually present in Copper when x-rayed in an oxygen rich environment. This experiment showed an increase in oxygen content for all materials irradiated with a rhodium source. Evidence suggests x-rays induced a reaction at the surface which creates an oxide layer for all materials investigated. In most instances, the oxide layer forms a corrosion resistant surface layer. Limited evidence suggests an improvement in adhesion resulting from oxygen availability at the coating and substrate interface.

**Research Paid for by Rowan University Summer Undergraduate Research Project

Presenter: DOUGHTY, Dorothy (Rutgers University)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **57** Type: **not specified**

An universal equation to predict $\Omega_{\rm m}$ from halo and galaxy catalogues

Saturday, 21 January 2023 16:30 (1h 30m)

We present analytic equations that can infer $\Omega_{\rm m}$ from the positions and velocity modulus fields of dark matter halos and galaxies. We first train a graph neural network with a sparse latent space on halo catalogues from Gadget N-body simulations to perform field-level likelihood-free inference of $\Omega_{\rm m}$. The network is trained using the relative positions and velocity modulus of halos and is able to infer the value of $\Omega_{\rm m}$ a mean relative error of $\sim 6\%$. We then extract analytic equations that can approximate this learned model using symbolic regression and find that the equations preserve the accuracy with mean relative error of $\sim 7\%$. We find that model is extracting information on small scales of $\leq 1.35\ h^{-1}$Mpc. Additionally, we find that the equations also preserve the model robustness as they achieve comparable accuracy for predictions of $\Omega_{\rm m}$ for halo catalogues from thousands of N-body simulations run with five different N-body codes: Abacus, CUBEP^{3}M, Enzo, PKDGrav3, and Ramses. Similarly, they also also work when tested on thousands of state-of-the-art CAMELS hydrodynamic simulations run with four different codes and subgrid physics implementations. This demonstrates the abundance of robust information embedded in phase space distribution of cosmological structures. Moreover, in some cases the found analytic equations can extrapolate even better than the GNN when presented with data points that exist outside the range of previously encountered data. Our results illustrate the effectiveness of using symbolic regression to approximate sparse representations in GNNs to discover novel physical relations for field-level cosmological inference. We speculate that the found relations take advantage of the initial cosmic velocity fields which might be insensitive to baryonic effects on the considered scales where the linear Zel'dovich approximation dominates.

Presenter: SHAO, Helen (Princeton University)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **58** Type: **not specified**

Dust Cleaning The Cosmic Microwave Background

Saturday, 21 January 2023 16:30 (1h 30m)

Dust Cleaning The Cosmic Microwave Background
Simon Foundations, National Physics Society, Steve Choi and Zachary Huber (Cornell University)

Cosmology big question is how the universe began, this research will contribute to finding out the answer to this. A theory that this is based on is the Big Bang theory which explains the expansion of the universe. The CMB is the cosmic microwave background which is the oldest primordial light that has been streaming through the universe since the Big Bang. It is like a fossil that will help scientists learn more about the early universe. Dust are unwanted particles floating around the universe . They get in the way of our calculations. The data used in this research is from the Actama telescope(in Chile) and the Planck's satellite. Pixell and healpy packages were used, then the reprojection of maps at 353GHz and 150 GHz, apodization, fourier transform and ultimately the calculation of the power spectrum (aka the cross-spectrum and/or the auto-spectrum) of the two maps were done. Dust will be found in order to "clean" by subtracting the frequency signals with the cmb signals. The power spectrum computations showed that dust is higher at a higher frequency and that dust dominates the cmb signal.

Presenter: CHARLES, Woodkensia (Haverford College)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **59** Type: **not specified**

Embracing Contact Resistance in the Design of High-Performance Low-Cost, Flexible Electronics

Saturday, 21 January 2023 16:30 (1h 30m)

Organic semiconductors (OSC) are exciting materials for incorporation of novel technologies. OSCs can be solution processed in a scalable manner, have high mechanical flexibility, tunable optoelectrical and chemical properties, and excellent biocompatibility. They enable devices like ultra-thin solar cells, flexible and bendable displays and printable communication devices. Here, we focus on the organic field-effect transistor (OFET), which can function like an electrical "on/off" switch in such applications, but there are bottlenecks that prevent its incorporation in real world technologies. For instance, an energy difference between the contacts and the semiconductor creates a Schottky injection barrier, constricting electric current flow; thus, we search for a way to minimize the effect of this barrier on the device performance. Rather than using an inefficient and expensive trial-and-error approach, we use a data-driven approach by running transistor simulations on the DEAC cluster. Our 1,800 OFET simulations showed that tuning the dielectric capacitance layer can restore performance in devices with an injection barrier. Our experimental results concurred with the simulations: in OFETs with Schottky contacts the mobility depended strongly on the capacitance, and the performance of the low-capacitance devices matched that of OFETs with high-quality contacts. These results broaden the selection of contact materials to include those that create injection barriers, which is desirable because many of the solution-processed conducting materials fall into this category. We used printed metallic polymer contacts and obtained device mobility of 5.5 cm2/Vs, the highest mobility reported for a fully printed OFET.

Presenter: YU, Yue (Wake Forest University)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **60** Type: **not specified**

Investigations into Sensitivity of Novel COVID-19 Biosensor

Saturday, 21 January 2023 16:30 (1h 30m)

The COVID-19 pandemic necessitated the quick production of PCR tests and rapid antigen tests to diagnose a quick uptake in cases. However, the current diagnostic tests have less than desired sensitivity or too long a wait time until complete diagnosis. The Daniels lab previously constructed a biosensor to detect COVID-19 by immobilizing COVID-19 spike protein polyclonal antibody onto quasi-freestanding epitaxial graphene (QFS-EG) to detect the spike protein antigens of the virus. This biosensor is able to detect COVID-19 spike protein antigens with concentrations as low as 1 ag/mL. However, the reason behind this sensor's extreme sensitivity was yet to be understood. To better understand this sensitivity, we constructed biosensors out of hexagonal boron-nitride on graphene(h-BN-g), a material comparable to QFS-EG. As opposed to a complete left-shifting of the G peak of the graphene as found in the QFS-EG biosensor with each additional layer added to the sensor, there was only a partial left shifting of the G peak in the h-BN-g biosensors. This points to a limited functionality of the graphene in the h-BN-g biosensors, due to an absence of the same strain interactions that exist between the QFS-EG and its SiC substrate. Thus, we conclude that the QFS-EG heterostructure is the optimal one for detecting COVID-19 and can be used in the future to detect other viruses.

Presenter: KHAN, Aimen (Swarthmore College)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **61** Type: **not specified**

Constructing a Basis for Image Reconstruction and Noise Reduction using Principal Component Analysis

Saturday, 21 January 2023 16:30 (1h 30m)

Principal component analysis (PCA) can be used to generate an orthogonal set of principal components, or an orthogonal basis, which can be used to reconstruct elements within and outside of the test set. In this project, a set of images was used to create a set of principal component images (or "eigenimages"), each of which accounts for a certain percent variation (first eigenimage accounting for most variation). The experiment involved taking images of atoms, and taking a background image a few seconds later. Both images are noisy, but most of the noise cancels when the images are divided element wise. We attempt to use PCA to reconstruct a "synthetic" background image that could be used in place of the real background image to reduce even more noise in the images. However, the technique was not yet found successful, as the real image worked better than the "synthetic" image reconstructed using PCA. Here, we summarize the various attempts at implementing PCA in MATLAB to accurately synthesize an image from an image set.

Presenter: NADGOUDA, Shrinidhi (University of Virginia)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **62** Type: **not specified**

Fluorophore Self-Assembly in Liquid Crystals

Saturday, 21 January 2023 16:30 (1h 30m)

Liquid crystals are a state of matter between liquid and solid that is observed in various substances. They are characterized by a clear directional order of the molecule called the nematic phase. We are analyzing the behavior of 4-Cyano-4'-pentylbiphenyl (5CB) molecules in response to various external fields, which are conditions often used in liquid crystal displays (LCDs). While 5CB behavior in electric fields is well understood, its characteristics in magnetic fields are yet to be studied. Past work in the Yodh Lab has investigated droplets of 5CB and how their configuration transforms under a magnetic field. In this project, we are using the fluorophore 4,4-Difluoro-5,7-Dimethyl-4-Bora-3a,4a-Diaza-s-Indacene-3-Pentanoic Acid (BODIPY-C5) to visualize and understand the defect transition of radial 5CB drops in response to magnetic fields. With zero applied magnetic field, radial droplets with 5CB molecules arranged from the center to the outer edges were observed. As the magnetic field was increased, the 5CB molecules rearranged to be increasingly aligned with the direction of the field. Similarly, droplet defects (regions in which 5CB molecules do not have a uniform direction) also changed configuration, starting out as a point defect in the zero applied magnetic field configuration and opening up to a ring defect with an increasing magnetic field. To anticipate how the fluorophores will behave along a defect, we first add them to topological defects that are synthetically formed using the planar rubbing procedure of ITO-coated substrates. Fluorescence microscopy is used to observe and take images of droplets through reflected light, and the fluorescence intensity distribution is quantified using ImageJ software. Preliminary results of the fluorophores in the drops show that at zero magnetic field, the fluorescence intensity is lowest towards the center of the radial droplets containing the point defect. Future work includes using confocal microscopy to analyze the layers of the 3-dimensional droplets and quantify the change in intensity over an increasing magnetic field.

Presenter: MANDIC, Mina (Swarthmore College)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **63** Type: **not specified**

Atomic-scale studies on the dissociation of CO2 over single Sn atoms dispersed on Au(111)

Saturday, 21 January 2023 16:30 (1h 30m)

We utilize scanning tunneling microscopy (STM) to probe the nanoscale architecture of catalytic systems consisting of tin (Sn) deposited on inert gold substrates. Upon CO2 exposure, CO2 is captured and dissociated in places where there are two or more adjacent single Sn atoms. This results in O-terminated Sn formations that are observed to move around the gold surface. Notably, our results suggest that the activation of CO2 by single Sn atom catalysts need not take place in harsh environments. The feasibility of catalytic function at low temperatures will have an enormous impact on developing industrial methods of CO2 capture and utilization, ultimately leading to a significant reduction of greenhouse gases in the atmosphere.

Presenter: YI, Sophia (University of Virginia)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **64** Type: **not specified**

Modelling Magnetic Field Growth in Disc Galaxies within the Framework of α – Ω Dynamo Theory

Saturday, 21 January 2023 16:30 (1h 30m)

The origin of magnetic fields in the universe and the role of individual galaxies in it is still an open question in modern cosmology. Observational data such as the polarization and intensity of total radio synchrotron emission have historically allowed for a better study of the strength and the shape of the magnetic fields in galaxies. More recently, cosmological simulations of magnetic fields in disk galaxies using magnetohydrodynamics equations provided insight into how magnetic fields in a galaxy have grown throughout time. Here, we use one of the preferred theories for field evolution, α – Ω galactic dynamo theory, based on the idea that magnetic fields of most galaxies are sustained by dynamos, mechanisms that convert ordered and turbulent plasma flow into magnetic energy to investigate factors that can realistically create and amplify the magnetic field values seen in modern astronomical observations. We utilize the Adaptive Mesh Refinement solver RAMSES developed by Teyssier (2002) in order to explore factors that distort or amplify the magnetic field lines within a galaxy. We further simulate the α – Ω galactic dynamo through the subgrid turbulent dynamo model developed by Liu et. al. (2022). It was found that for seed magnetic fields with strengths 1E−10 G, α – Ω dynamo is successful in generating the magnetic field strength values we observe in galaxies today. It was also found that magnetic field evolution is influenced by a combination of internal processes that make up the simulation (i.e. subgrid turbulent dynamo) and the initial conditions, namely, the initial field topology, uniformity, and the magnetic field strength.

Presenter: KARAASLAN, Inci (Princeton University)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **65** Type: **not specified**

Effects of Thermal Variations on Lipid Monolayer Molecular Packing

Saturday, 21 January 2023 16:30 (1h 30m)

Lipids exhibit distinct transitions between the gel and fluid phase depending on various factors, such as the length of their fatty acid chains, the number of double bonds in the chains, and temperature. Our cell membranes contain different forms of lipids, with ratios that depend on cell membrane type. Therefore, how lipid molecules pack at different temperatures and within mixtures with other lipids is important to our understanding of the biological function of lipid membranes and their use as drug delivery carriers, also known as liposomal drug delivery. Common issues in liposomal drug delivery are the stability and circulation time of liposomal carriers. Importantly, liposomal structure is heavily influenced by temperature, which alters the physical state of lipids and their packing states. Here, we use 1,2-dimyristoyl-sn-glycero-3 phosphocholine (DMPC) to study the effect of thermal variations on lipid packing. Using Langmuir area-compression isotherms, we observe how the mean molecular area (Mma) of lipids changes over a range of temperatures, below and above the gel-fluid phase transition of DMPC. All mean molecular areas are reported at a surface pressure of 30 mN/m; i.e. ~ the surface pressure of biological membranes. Our measurements show that the mean molecular area increases with increasing temperature, in agreement with previous studies using other characterization methods. By comparing our results to studies of membrane mechanics, we infer that liposomal stability strongly depends on molecular packing – of direct implications in the design of stable liposomal carriers.

Presenter: ZIU, Eleni (Virginia Tech)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **66** Type: **not specified**

How Do Different Angled Inclines Affect the Accuracy of an iPhone 12's Accelerometer

Saturday, 21 January 2023 16:30 (1h 30m)

Smartphones contain many sensors that can be used in a multitude of different contexts. Following a past experiment we conducted that confirmed an anomaly in the measurements, that we have not found in literature, a new question came to the forefront. An iPhone12 and a PASCO Scientific Accelerometer were placed onto a cart and sent down an incline to compare their measurements of acceleration. In the past experiment, we saw that the iPhone12's acceleration measurements decayed rather than staying the same for the duration. This experiment set out to find if there is a correlation between the angle of the incline and the rate that the acceleration decreases according to the iPhone. Finding this will help in the next steps of the overall goal to use a smartphone as an inertial navigation system. Further experiments will need to be done.

Presenter: SCHRIEVER, Erin (Randolph College)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **67** Type: **not specified**

Effects of Sterol Modified Lipids on Molecular Packing in Lipid Monolayers

Saturday, 21 January 2023 16:30 (1h 30m)

Liposomal drug delivery is a promising, effective therapeutic approach; it has been used for COVID-19 vaccines as well as cancer therapies. However, most liposomal formulations lack the needed stability for long enough circulation prior to reaching the target or getting cleared out of the blood stream. To mitigate this shortcoming, current liposomal formulations use cholesterol as a stabilizing agent. However, cholesterol tends to rapidly exchange out of liposomes, eventually compromising liposomal stability. This study investigates sterol-modified lipids (SMLs) as substitutes for cholesterol for the purpose of improving liposomal stability. Using Langmuir compression isotherms, we compared the packing properties of lipid monolayers rich with SMLs and cholesterol. Therefore, we collected data from two lipid mixtures: (1) 1-palmitoyl-2-oleoyl-glycero-3-phosphocholine (POPC) with cholesterol, and (2) POPC with 1-palmitoyl-2-cholesterylhemisuccinoyl-sn-glycero-3-phosphocholine (PChemsPC). Our results show that both cholesterol and SMLs induce a condensing effect in POPC monolayers, manifested in tighter molecular packing than theoretically predicted. These results are confirmed by Gibb's free energy analysis which shows more favorable interactions in POPC-PChemsPC mixtures compared to POPC-cholesterol mixtures. Combined with our neutron spectroscopy studies of the mechanical properties of liposomes with equivalent compositions, we find a strong correlation between molecular packing and liposomal stability. These findings provide a molecular-level rationale for the use of SMLs as superior candidates in the design of more stable liposomal carriers for drug/vaccine delivery applications.

Presenter: ZIU, Maria (Virginia Tech)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **68** Type: **not specified**

Progress toward a rotating optical Cs-Hg comagnetometer to detect long-range spin-spin interactions

Saturday, 21 January 2023 16:30 (1h 30m)

The Hunter Lab searches for long-range spin-spin interactions as a potential fifth fundamental force of nature. Using a Cs-Hg comagnetometer, we measure the long-range effect of unpaired geo-electrons in Earth's mantle on the spin precession frequencies of Hg-199 nuclei in the lab. We seek to optimize our apparatus to increase the sensitivity of our measurements by an order of magnitude from previous experiments. Toward this end, the goal of this research is to modify our comagnetometer and to assemble it on a rotating optical table, allowing us to orient the comagnetometer's magnetic field along each of the cardinal directions. Here, I present the design of our comagnetometer, new modifications to its optical layout, and our initial steps toward construction of the apparatus. We successfully mounted our comagnetometer on the rotating table and aligned the lasers and optics, allowing us to begin preliminary data acquisition.

Presenter: HERZ, Bek (Amherst College)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **69** Type: **not specified**

Current constraints on dark matter-interacting stepped dark radiation

Saturday, 21 January 2023 16:30 (1h 30m)

The Hubble and S8 tensions exist between direct and indirect measurements of the universe's expansion rate today and the clustering of matter in the universe. We examine two models constructed to alleviate both tensions. Both models inject a strongly self-interacting dark radiation (DR) fluid that also interacts strongly or weakly with some or all of the dark matter (DM). The DR energy density increases at some redshift, increasing the size of the sound horizon and thus alleviating the Hubble tension. The DM interactions suppress the growth of matter perturbations alleviating the S8 tension. The weakly interacting model is able to resolve both tensions and provide a good fit for all data. However, the inclusion of high-resolution cosmic microwave background data (ACT DR4 and SPT-3G) constrains the model and limits its ability to resolve the Hubble tension and full-shape (i.e. 'EFT of LSS') BOSS DR12 and eBOSS galaxy clustering limits its ability to resolve the S8 tension. The strongly interacting model incorporates dynamics that extends to later times than the weakly interacting model, leading to tight constraints using Planck CMB data alone. We investigate how these data sets respond to these models in order to understand the requirements for mechanisms to address both tensions.

Presenters: BARTLETT, Alexa (Swarthmore College); PATEL, Yashvi (Swarthmore College)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **70** Type: **not specified**

Bryn Mawr Plasma Laboratory Projects Report

Saturday, 21 January 2023 16:30 (1h 30m)

The Bryn Mawr Experiment (BMX) is an experiment designed to measure and study plasma dynamics as turbulence movements. The BMX is a long chamber at high vacuum in which a plasma is created by puffing a small amount of hydrogen gas into the first section of the chamber where an electrode, powered by external capacitor banks, creates a voltage difference and ionizes the hydrogen into a plasma, which is then released down the rest of the chamber past the data taking probes before reaching the final section where the plasma cools back into gas.

In the past year, I worked on many smaller projects related to the BMX. The first is a small-scale test model of the main experiment called the glow discharge experiment. The second was building and testing a fast ionization gauge which will allow us to measure the velocity of the plasma in the BMX. Meanwhile, two statistical analysis methods known as PESCy and Bispectral Analysis are implemented to investigate wave coupling. We aim to testify the relationship between maximum complexity of time series and energy transfer between wave frequencies.

Presenter: LI, Yuqian (Bryn Mawr College)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **71** Type: **not specified**

Physics-based adaptive learning to resolve overlapping molecular line transitions in mid-infrared spectroscopy

Saturday, 21 January 2023 16:30 (1h 30m)

Mid-Infrared laser-based sensing using molecular spectroscopy is commonly used for trace-gas detection and density measurements. An obvious advantage in detection in the mid-IR region is the fundamental absorption bands of several molecular species of interest for environmental, biomedical, and industrial processing applications. Several challenges in mid-IR sensing are due to significant interference and overlapping line transitions of molecular species with broad collision linewidths. Therefore, in many instances, the absorption signal is congested, overlapping line transitions of disparate molecular oscillator linestrenghts. In this project, we show a novel experimental methodology integrated with adaptive learning techniques to discriminate, quantify and resolve overlapping line transitions of nitrous oxide, water vapor, and methane in the spectral region of 4 um to 10 um. The trace gas detection and machine learning-based classification method utilize the structural complexity of higher harmonic wavelength modulation spectroscopy signals that encode molecular collision dynamics information.

Presenter: JURACKA, Zayna (Delaware State University)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **72** Type: **not specified**

Pacemaker/Implantable Cardiac Defibrillator SAVI Dose Predictions Using HDR Brachytherapy

Saturday, 21 January 2023 16:30 (1h 30m)

BACKGROUND – Pacemakers and Implantable Cardiac Defibrillators are extremely sensitive to radiation. To minimize the exposure of radiation to these devices, doctors and physicists may choose to use APBI via brachytherapy, using the SAVI device to best cover the PTV. For physicists to best plan for these patients, there needs to be an understanding regarding the dose delivered at differing distances to describe the dose a pacemaker/ICD would receive.

METHODS – The four different SAVI sizes, 6-1 Mini, 6-1, 8-1, and 10-1, were scanned from a CT scanner and digitized using brachyvision treatment planning system. Three different aspects of the SAVI were then tested to see which had importance on the dose delivered at various distances. These aspects were the orientation of the SAVI, the size of the SAVI, and channel weighting. The TPS was then used to calculate the dose at various distances, and the data was compiled and compared.

RESULTS – We found in our study that the aspects of the SAVI that most affected dose calculations were the orientation and the SAVI size. The channel weighting did not matter as much. Using varying guidance from TG-203, if accumulated device dose is preferred as less than 5 Gy, for each size the device should be at least 5 cm from the tip or 6 cm from the perpendicular bisector. If accumulated dose is preferred as less than 2 Gy, then for each size the device should be 10 cm away from either tip or perpendicular bisector.

Presenter: DICKSON, Lily (University of Richmond)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **73** Type: **not specified**

Strategies for Transferring to a 4-Year College or University

Saturday, 21 January 2023 09:45 (1 hour)

Presenters: BUSTIN, Alex (Princeton University); SHAW, Keith (Princeton University)

Session Classification: Workshops

Contribution ID: **74** Type: **not specified**

Strategies for Transferring to a 4-Year College or University

Saturday, 21 January 2023 12:45 (1 hour)

Presenters: BUSTIN, Alex (Princeton University); SHAW, Keith (Princeton University)

Session Classification: Workshops

Contribution ID: **75** Type: **not specified**

Symmetry Breaking in the Scalar Higgs Potential

Saturday, 21 January 2023 16:30 (1h 30m)

From the Great Pyramids of Giza to snowflakes, symmetries are everywhere. But symmetries lie deeper than snowflakes, even deeper than molecules! For something to be symmetrical, it remains unchanged under some transformation. Symmetries can also be broken. This occurs when an object's symmetry changes after it goes through some transition. This concept extends into the fundamental particles that make up the Universe. These symmetries are accounted for by the Standard Model Lagrangian, which is a mathematical formulation of most of the fundamental forces that we observe: electromagnetism, the strong nuclear force, and the weak nuclear force. We are investigating a scalar Higgs potential model in order to understand symmetry breaking. This term accounts for the spontaneous symmetry breaking mechanism. By applying a symmetry group transformation onto the critical points of the scalar Higgs potential, we can examine exactly where symmetry breaking occurs. This will carry on to future work where we look at this concept from a topological understanding using Morse theory, which allows us to find topological invariants using special equations, which will be derived from the scalar Higgs potential. Using this, we can put a limit on the number of symmetry-breaking patterns for different groups, and by virtue, different models. By developing our topological understanding of symmetry and symmetry breaking classically, we also hope to see if we can learn anything about the quantum effects of symmetry breaking through the lens of topology, while also being able to apply this to other models that describe symmetry.

Presenter: SWANSON, Abigail (University of Mary Washington)

Session Classification: Poster Session + Grad/Career Fair

Contribution ID: **76** Type: **not specified**

Diversity in STEM Discussions

Saturday, 21 January 2023 09:45 (1 hour)

Join the Fields Fellows as they hold a space for undergraduate STEM students to share and engage with others about their own experiences and challenges with barriers in STEM/Physics. Students will have an opportunity to brainstorm and collaborate together to imagine and create a new world by devising solutions and recommendations for more inclusive practice and addressing in STEM/Physics departments and the field generally.

Goals of this space:

We want to provide a space for undergraduate students to share openly about their experiences with diversity in STEM/Physics.
We aim to uplift the experiences, concerns, and voices of marginalized people in STEM/Physics.
We will provide general knowledge of microaggressions and biases in hopes that this discussion allows for collective community brainstorming and action steps.

Presenter: FELLOWS, Fields

Session Classification: Workshops

Contribution ID: **77** Type: **not specified**

Diversity in STEM Discussions

Saturday, 21 January 2023 12:45 (1 hour)

Join the Fields Fellows as they hold a space for undergraduate STEM students to share and engage with others about their own experiences and challenges with barriers in STEM/Physics. Students will have an opportunity to brainstorm and collaborate together to imagine and create a new world by devising solutions and recommendations for more inclusive practice and addressing in STEM/Physics departments and the field generally.

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Presenter: FELLOWS, Fields

Session Classification: Workshops

Contribution ID: **78** Type: **not specified**

Diversity in STEM Discussions

Sunday, 22 January 2023 10:00 (1 hour)

Join the Fields Fellows as they hold a space for undergraduate STEM students to share and engage with others about their own experiences and challenges with barriers in STEM/Physics. Students will have an opportunity to brainstorm and collaborate together to imagine and create a new world by devising solutions and recommendations for more inclusive practice and addressing in STEM/Physics departments and the field generally.

Goals of this space:

We want to provide a space for undergraduate students to share openly about their experiences with diversity in STEM/Physics.
We aim to uplift the experiences, concerns, and voices of marginalized people in STEM/Physics.
We will provide general knowledge of microaggressions and biases in hopes that this discussion allows for collective community brainstorming and action steps.

Presenter: FELLOWS, Fields

Session Classification: Workshops