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The 2023 SPS Internship Symposium Abstracts
Friday, August 4, 2023

Brynn Schierenbeck, Society of Rheology/Soft Matter Kitchen
Cornell College
The Soft Matter Kitchen: Exploring Viscoelasticity through Dairy Products
Presentation Time: 10:10 AM ET

The Soft Matter Kitchen was created as an educational outreach website for the Society of Rheology to introduce rheological concepts through food. This presentation focuses on viscoelasticity, one of the key phenomena of the field of rheology, which describes the time-dependent solid and fluid-like behaviors of many materials including foods. By observing how food behaves under relatively simple conditions, one can infer much about the rheological properties it possesses. Using the demonstrations I developed this summer; I present how one can use at-home experiments to determine the viscoelastic properties of regular versus dairy-free cheese and edible silly putty. This is done to encourage others' understanding and conceptualization of rheology from their kitchen table.

Melissa Cano, American Association of Physics Teachers
University of Texas at El Paso
The Art and Science of Teaching
Presentation Time: 10:20 AM ET

Physics Education Research (PER) is a scientific discipline aimed at understanding how students learn physics and how teachers can effectively teach physics concepts. This research focuses on the best strategies to help students grasp challenging physics topics, thereby enhancing their overall learning experience. By identifying misconceptions and supporting evidence-based teaching, PER plays a pivotal role in bridging the gap between research and practice in physics education. PER uncovers novel insights into how students comprehend fundamental concepts, having the potential to challenge traditional paradigms in physics education. One of the key aspects of PER's significance lies in its contributions to the advancement of physics. Embracing evidence-based solutions, PER addresses the challenges encountered in physics education, fostering continuous growth and improvement in the field. Undergraduate physics education can benefit from research into different pedagogical techniques. PER helps evaluate the effectiveness of various teaching methods, allowing instructors to make evidence-based decisions in their instructional practices. By integrating physics education research into undergraduate schools, institutions can create a more supportive and effective learning environment, resulting in better-prepared physics graduates and potentially inspiring more students to pursue careers in physics and related fields.

Clayton Markech, NIST Gaithersburg
Carthage College
Verification of Polarization Quantum Entanglement Between Two Photons
Presentation Time: 10:30 AM ET

We experimentally verified the quantum entanglement between two polarization states of a single photon pair. The experimental setup is based on a Polarization Sagnac interferometer in which a periodically poled potassium titanyl phosphate (PPKTP) crystal is placed for generating two superposed biphoton pairs with orthogonally polarized states using bidirectional spontaneous parametric down-conversion (SPDC). The correlation between the two polarization-entangled photons propagating in distant directions is examined by measuring a set of quantum interference graphs as their relative polarization states are scanned. The analyzed data shows quantum interference visibilities of greater than 99.7%, which show a strong correlation between the two separate photons. The Clauser-Horne-Shimony-Holt inequality value for Bell's nonlocality test is $S = 2.8177 \pm 0.0032$ (theoretical maximum 2.828), verifying the two photons are strongly entangled in polarization.

Janessa Slone, NIST Gaithersburg
Embry-Riddle Aeronautical University – Prescott
Modeling the two-quantum coherent spectrum of a semiconductor microcavity
Presentation Time: 10:40 AM ET

Nanoscale Device Characterization advances as researchers begin to dive deeper into the theory side of polariton dynamics in a semiconductor microcavity. Multidimensional optical spectroscopy allows physicists to isolate subtle effects in light-matter interactions. It relies on exciting a sample with a series of ultrashort optical pulses and measuring the coherent emission as a function of the time delay between the pulses. Semiconductors have quasiparticles called excitons, or bound electron-hole pairs, that strongly interact with photons and each other (the latter through "many-body" interactions). In specially designed nanostructures called microcavities, the interaction between excitons and an optical cavity mode is enhanced further, and hybrid particles called exciton-polaritons are formed. Understanding the dynamics of this system is important for developing new optoelectronic devices, but many-body interactions between these polariton states have only recently begun to be studied. Here we develop a model of the nonlinear response of a gallium arsenide semiconductor nanostructure. In the polariton basis, 2D Feynman Diagrams were deconstructed into a set of expressions, leading to a simulation of a 2-quantum spectrum. The next step will be to add many-body interactions to this simulation and compare it to experimental spectra.

Colin Myers, NIST Gaithersburg
Millersville University
Hydrogen-Terminating the Surface of Diamond Via Thermal Hydrogenation
Presentation Time: 10:50 AM ET

Diamond has several electrical properties of interest to scientists. Classified as a wide band-gap semiconductor, its high breakdown voltage, thermal conductivity, and resistance to radiation damage make diamond ideal for electronic devices subjected to harsh conditions and large power intakes. Over the past 20 years, scientists have experimented with reducing diamonds' natural resistivity to levels more consistent with contemporary semiconductor materials. Varied methods of surface termination and substitutional doping have been explored to accomplish this. I examined a method of thermal hydrogenation using forming gas, followed by atmospheric exposure. The results of this relatively simple and inexpensive method have been promising and hold industrial potential.

Tiffany Liou, Space Telescope Science Institute
University of California, San Diego
Rest-UV Properties of MUSE DR2 Galaxies in Redshifts 2.803 < z < 3.973
Presentation Time: 11:00AM ET

In recent years, deep field surveys from the Hubble Space Telescope and MUSE on the Very Large Telescope have shed light on early faint galaxies. The second data release from MUSE HUDF (Hubble Ultra Deep Field) Survey, has a 1 arcmin diameter field of view and a depth of 141 hours, giving it higher spatial and redshift resolutions. The high sensitivity of MUSE allowed for the detection of 1308 Ly-α emitter galaxies (LAEs) (EW(Ly-α) > 20 Å) within redshifts 2.8 < z < 6.7 (Bacon et al. 2022). These LAEs provide good opportunities to study rest-UV properties in galaxies. We select a sample of 121 galaxies in redshift 2.803 < z < 3.973, 99 of which are LAEs. This redshift range is constrained by galaxies with a large redshift confidence (zconf ≥ 3) and signatures of Ly-α, CIV λ1548,1550, HeII λ1640, and CIII] λ1907,9. Using this sample, we study the correlation between properties such as stellar mass, gas-phase metallicity, star-formation rate, line strengths, and redshift. We compare these results with those found for lower redshift galaxies. The various trends found between different properties within our galaxy sample and their similarities and differences with lower redshift galaxies must be further investigated.

MJ Keller, AIP Center for History of Physics and Niels Bohr Library & Archives
University of Rochester
A Historical Walk Through Atomic Theory Presentation Time: 11:10 AM ET

The Niels Bohr Library and Archives is host to physical and digital resources from the world's history of achievements in physics, optics, mathematics, astronomy, and related fields, and the Center for History of Physics offers connections to the physics community at large through outreach and writing. Through the lens of the development of atomic theory--one of the greatest, most unifying theories developed in modern history--this talk will be an overview of work completed this summer. Methods covered range from Wikipedia editing to curriculum creation to non-fiction article writing, with their topics presented along with developments and discoveries in atomic theory that were underway at the same time.

Emily Pavasars, AIP SPS SOCK
Valparaiso University
A Summer of Outreach
Presentation Time: 11:20 AM ET

This talk will outline my summer of outreach: representing SPS and Sigma Pi Sigma at Astronomy on the Mall and the development of the 2023 Science Outreach Catalyst Kit (SOCK). With a theme of Eclipses, there are three central demonstrations accompanied by write-ups and instructional videos within the SOCK. Other resources include materials to help SPS chapters set up an effective outreach table for the 2023 and 2024 eclipses and educate their members and the public. The physics and astronomy jeopardies are designed to include all ten federation societies under AIP to show the diversity of interests in the Physical Sciences community. The goal of the SOCK internship is to advance outreach resources in Physics and Astronomy and this talk will demonstrate how this was accomplished in the summer of 2023!

Hannah Means, AIP Physics Today
Bowling Green State University
Finding a Voice in Science Journalism
Presentation Time: 11:40 AM ET

The way information is communicated to the world has rapidly changed over the last several years. More and more people are accessing their science news through short-form content and social media rather than print. How do magazines keep up, and where does someone new to journalism fit into this process? How can a science background help someone build a career as a writer? This presentation explores the many steps of creating an article, from finding an intriguing research result to publishing a polished piece. I show how this process resulted in my first few publications, discuss the skills and lessons learned from my time at Physics Today, and how it all shaped me as a writer.

Daniil Ivannikov, NIST Gaithersburg
Florida Polytechnic University
Automated recognition of exfoliated two-dimensional materials using Python OpenCV library.
Presentation Time: 11:50 AM ET

Two-dimensional (2D) materials are a class of nanomaterials that consist of a single- or few-layers of atoms and possess exceptional physical and chemical properties. Such unique properties of 2D materials made them a focal point of research to use them in the production of electronic and nano-electronic devices such as transistors, sensors of various applications, electrodes, etc. There are several ways to make 2D materials, and one of the easiest and most widely used research methods is Mechanical Exfoliation, also known as the Scotch Tape method, where flakes of various sizes and thicknesses are randomly split from bulk materials and transferred to a chosen substrate using adhesive tape. Before flakes can be further utilized, they need to be identified on the substrate and that process is usually done manually using optical microscopy as a starting tool and other lower-throughput methods for more reliable final identification. Manual search and identification of flakes is a time-consuming and involved process that requires expertise to be done efficiently. Furthermore, it gets less effective the smaller the flakes are. There have been efforts to automate flake search and characterization using machine learning (ML) [1,2]. There are examples of ML algorithms that are extremely accurate in identifying flakes. However, ML has some drawbacks that prevent it from being a widely applied tool for 2D materials flakes, especially for new material types or new transfer methods: lack of training data for the model, variable samples/substrates, high requirement for computing power or time. The proposed solution to the efficient recognition and sorting of 2D material supported by the automation is to use a general non-ML algorithm that relies on some user input and general visual properties of 2D material flakes, such as transparency and color difference between single and multiple layers of material, to identify and possibly characterize flakes with minimum computing power/time required.

Eva Rissanen, NIST Gaithersburg
Appalachian State University
How Small is Too Small?
Presentation Time: Noon ET

Measuring a small-scale capacitor from the bottom of a cryostat with a large parasitic capacitance can prove to be tricky! Most electronics are designed to function at temperatures ranging from 280 to 300 Kelvin, so it is essential, as science looks to space, to know how the physical properties and functions of circuits change once subjected to cryogenic temperatures. A small circuit chip containing several capacitors in the pico-farad to nano-farad scale was developed for this project. The voltage drop of each capacitor was measured using a time and frequency domain at room temperature, then again at a temperature of 4 Kelvin. Results concluded that the capacitance decreases in cryogenic environments. By quantifying the changes in many minuscule capacitors from warm to very cold, this project will help future endeavors in building larger-scale cryoelectronics.

Devin Kodsi, APS Education & Diversity
University of Alabama
An Analysis into the Demographics of Physics and STEM Education
Presentation Time: 12:10 PM ET

Physics and STEM education continues to have underrepresentation by individuals with marginalized gender, racial, and ethnic identities. As an intern for the American Physical Society, I worked with Dr. Christine O'Donnell to analyze the demographics of higher education degrees in physics and STEM. I used the Integrated Postsecondary Education Data System (IPEDS) from the National Center for Education Statistics (NCES) to collect data for degree completions disaggregated by gender, race, and ethnicity as defined by the database. My work included updating eighteen of the "Physics Graphs & Statistics" and nineteen "Top Educators" tables for APS web pages. Furthermore, I carried out additional analysis on the effects of using an updated definition for "STEM" that is more consistent with the National Science Foundation (NSF), National Academies of Sciences, Engineering, and Medicine (NASEM), and other groups. The new definition introduced fields with a higher fraction of degrees awarded to women, including Agricultural Sciences and Psychology, leading to greater female representation in STEM degrees. Overall, my work throughout the summer will help drive changes that support diverse students in science education.

Jaden Sicotte, APS Careers
George Washington University
Changing the Topography of Physics: Supporting Marginalized Physics Students by Enhancing the NMC Match System
Presentation Time: 12:20 PM ET

The National Mentoring Community (NMC) was fashioned in 2015 by the American Physical Society (APS) to build and maintain mentoring relationships between Black/African, Latinx, and Indigenous physics students and professionally established mentors. The sweeping objective of the program is to expand the

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demographics of students completing undergraduate physics degrees by supporting historically marginalized communities through mentoring focused on career development and academic success. However, many participants report that the program has yet to live up to its full potential, largely due to the difficulties of successfully making a mentor/mentee match. In fact, as of September 2022, of 235 total mentees and 385 total mentors, only 97 mentees and 104 mentors were matched with at least one mentor or mentee respectively. As a result, APS has decided to reevaluate the current match algorithm system in favor of a more effective process. This presentation was developed in conjunction with the APS Careers team using survey data from NMC members and an external appraisal by the WestEd firm to provide a recommendation and proposal for an updated match algorithm and workflow system. This recommendation intends to bolster the NMC engagement levels through an updated and refined matching system, and thus, establish more mentoring relationships.

Jenna Tempkin, APS Public Engagement
Lafayette College
Expanding the reach of APS PhysicsQuest using STEP UP principles.
Presentation Time: 12:30 PM ET

PhysicsQuest (PQ) is one of the American Physical Society's public engagement projects that aims to introduce middle school students to basic physics concepts through short activities and experiments. Recently, PQ has undergone updates to make physics more accessible and relatable as a career path, engage diverse students, focus on DEI pedagogical strategies, and incorporate principles from the STEP UP program. To ensure these changes are implemented, I created a set of guidelines that will be used by PQ developers and reviewers. These guidelines will help to ensure that the new goals of PQ are met in the future. Additionally, I have worked on adding extension activities, or "after the experiment" activities, to past and present PQ activities that teachers can use to further engage their students with physics concepts. These extension activities include making real-world connections, creatively presenting content, and a design challenge, all of which have been shown to connect with diverse student populations.

Julia Buccola, AIP FYI Science Policy News
Radford University
FYI Science Policy: The Policy Decisions That Shape Our Scientific World
Presentation Time: 12:40 PM ET

As scientists, the science-policy decisions made by Congress impact much of what we do, and staying informed on those decisions is both important and necessary. FYI Science Policy News allows anyone interested in science and the subsequent policy surrounding it to stay informed through the deployment of weekly newsletters, longer-form bulletin articles, and widgets on the FYI website that gives people the opportunity to explore specific legislation and budget decisions. This makes often-complex information more readily digestible to those who need it, and taking part in this internship showed me how valuable this access is. In this presentation, I will focus on the work that FYI does, how I contributed over the summer, why this information availability is valuable, and why scientists need to stay informed on the policy decisions that impact all of us.

Gizem Dogan, AIP Mather Policy
Bowdoin College
Manufacturing USA Initiative: Strategic Technology Ecosystems of the U.S.
Presentation Time: 12:50 PM ET

Manufacturing USA is a relatively new government initiative to form manufacturing ecosystems around the U.S. in efforts to on-shore production, develop a skilled American workforce, and build resilient and sustainable supply chains. As of today, Manufacturing USA has sixteen institutes working in strategic technology areas ranging from robotics and AI to biopharmaceuticals and photonics. This presentation focuses on the 2023 Mather NIST Policy Intern's task to develop a framework to draw inferences on these institutes' membership characteristics, which will potentially be built into a performance review mechanism to be used by the sponsoring agencies, the DOE, the DoD, and the DOC, in the future. This project draws from publicly available membership data to make observations pertaining to membership categories, longevity, and industry/academia participation. Aside from this project, the presentation will also touch upon other side activities the intern had participated in over the summer such as the NIIMBL Annual Meeting, Atlanta HI-TEC Conference, and technical drafting assistance for Congressional offices.

Ruthie Vogel, AIP Mather Policy
University of Maryland, College Park
Artificial Intelligence: The Complex Networks Behind Legislation
Presentation Time: 1:00 PM ET

Artificial intelligence is increasingly becoming more advanced and prevalent in all aspects of life, bringing to light the need for official standards and regulations. The regulatory process for emerging technologies like AI, however, is lengthy and includes a wide array of agencies and stakeholders both within and outside of all branches of government before any legislation can be proposed, much less enacted. In this presentation, I will discuss the vital importance of AI regulation and use AI to demonstrate the overall regulatory process. While working for the House of Representatives Committee on Science, Space, and Technology I was able to see a small segment of this process, but there is much more to AI regulation than just the Science Committee. The consequences and implications of AI are vast and far-reaching. By gaining a complete picture of the regulatory ecosystem, one can better understand the challenges and pitfalls that the U.S. is facing before any significant legislation – AI or otherwise – can be passed.

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