13th Annual oSTEM Conference

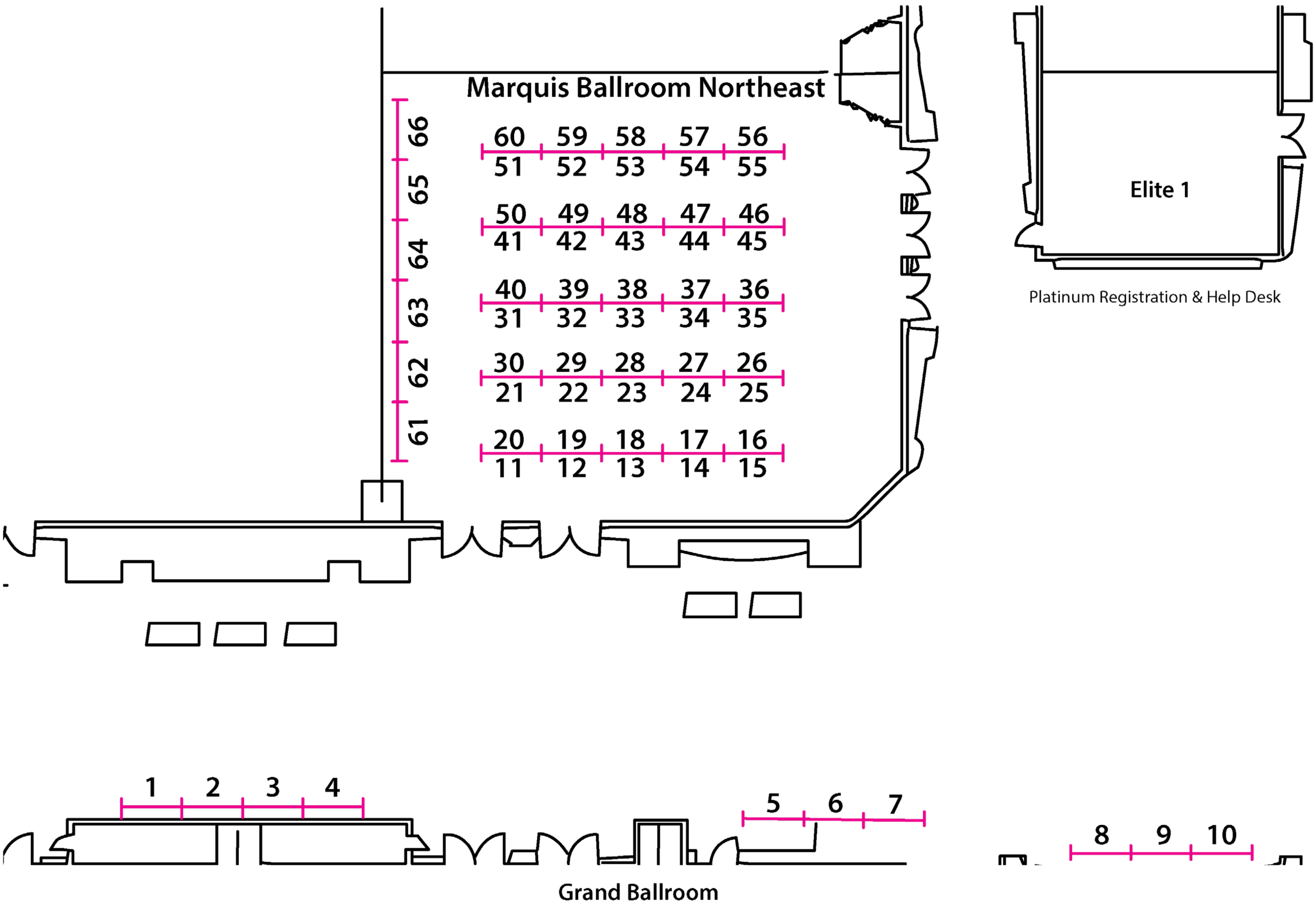
POSTER SESSION

abstract book

Saturday, Nov. 11, 2023
2:00 - 3:00 PM

MARQUIS BALLROOM NORTHEAST
ANAHEIM MARRIOTT HOTEL

Poster Session Map



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Poster #1

Metamaterial Menagerie: Designing and Characterizing Bio-Inspired Lattices for Orthopedic Splints and Braces

Amanda Westmoreland

Metamaterials are primarily manufactured and utilized for their unique support and weight distribution properties. These materials are often organized into lattices and 3D structures based on their foundational inspiration, offering a range of beneficial properties. Many lattices can manipulate ultrasound waves, exhibit bistable conditions, function as springs or dampers, and even possess optical capabilities that make them and the substances they interact with invisible. These diverse and exceptional capabilities have enabled researchers to explore applications in imaging, acoustics, energy harvesting, architecture, and more. However, despite their remarkable abilities and properties, many metamaterial applications have focused primarily on engineering-based fields, leaving medical and user-end applications largely unexplored.

This project proposes three unique bio-inspired lattices and presents their respective orthopedic applications. We have designed a lattice inspired by giraffe vertebrae, a lattice inspired by a conch shell, and a lattice inspired by the elephant carpal complex. This project's primary contribution is the introduction of three novel bio-inspired lattices. These lattices possess valuable properties that can be applied in various sports and orthopedic supports, braces, casts, and beyond. The explored applications in this project enable healthcare professionals and patients to adapt their supports to specific needs, injury progression, and personal comfort. The specific contributions of this project are as follows:
(1) Mechanical design of the elephant carpal complex and giraffe atlas vertebrae unit cells.
(2) Mechanical design of the conch shell unit cell.
(3) Exploration of orthopedic applicability, showcasing the ability for users to print, wear, and customize braces according to their specific requirements.

Amanda Westmoreland is a second year pre-med student at Texas A&M. She is a pansexual researcher and wants to become an OBGYN to advocate for women's health. She is a tutor and currently works with special education students to provide equity in education. This summer she participated in the NSF REU program at the University of Texas at Arlington and researched the applications of bio-inspired metamaterials. She hopes to apply research and help improve the lives of those with musculoskeletal issues and struggle with chronic pain.

Poster #2

Effects of Chronic Stress and Prefrontal Cortical REDD1 Overexpression on Attentional Set Shifting Behavior in Mice

Ali Beimborn

Cognitive (behavioral) flexibility, the ability to adapt behaviors in response to changes in the environment is an essential element for everyday life, with deficits commonly observed in neuropsychiatric disease states and reducing resilience to negative life events such as stress. The rodent prelimbic cortex (PrL) plays a critical role in processing information necessary for optimal cognitive flexibility and is known to undergo structural and functional changes following prolonged stress exposure, thus PrL dysfunction represents a likely substrate for stress-induced deficits in cognitive control. We have recently shown that chronic unpredictable stress (CUS) produces an enduring dysfunction in PrL physiology and impaired cognitive flexibility using an operant-based attentional set shifting in male but not female mice, however what adaptations drive these deficits remains unclear.

To gain more insight into this, our studies chose to focus on the protein REDD1 (regulated in development and DNA damage responses-1) (aka DDIT4, RTP801, Dig2) as it is increased in post-mortem dorsolateral prefrontal cortex (dlPFC) tissue from individuals diagnosed with depression. In line with these findings, we find that there is an increase in REDD1 expression and a decrease in Raptor phosphorylation, one of the key elements of the mTORC1 complex, in the PrL after CUS, suggesting disrupted mTORC1 function. To determine if REDD1 overexpression is sufficient to produce deficits in attentional set shifting, we used a viral vector to overexpress REDD1 in the PrL of male mice. Relative to control mice, REDD1 mice required more trials to pass the extradimensional shift testing criterion that was equivalent to that produced by CUS. The observation that CUS and REDD1 overexpression produce deficits in attentional set shifting in male mice likely has relevance for understanding a number of stress related disorders. Future research will assess the cell-type localization of REDD1 increases following stress in males, determine whether female mice are similarly affected by REDD1 overexpression and/or is upregulated in females following CUS and examine the necessity of disrupted mTORC1 for stress effects.

Ali is a current senior at Marquette University majoring in Biomedical Sciences, with minors in Spanish for the Health Professions and Psychology. She hopes to attend medical school to become a physician after taking a gap year. Outside of her research, Ali also works as a teaching assistant for Marquette's Doctor of Physical Therapy, Physicians Assistant, and Dental School programs in the Gross Anatomy Laboratory on campus, works as a campus tour guide and general chemistry tutor, is the secretary and a choreographer for Dance Inc, a student run dance group, and a member of Global Brigades, which is an international holistic service organization that was founded at Marquette. Ali has been researching the REDD1 protein and its effects on depression-like outcomes in mice with Beliz Kurtoglu in Dr. Wheeler's lab for the past year. After her graduation in May, she plans to continue to work in the clinical field where she has been a CNA, as well as hopes to continue to work in the research lab. In her free time, Ali loves to cook and bake, hang out with her friends, and of course spend time with her golden retriever Mia.

Poster #3

Model Studies to Inform Ribosomal-Promoted Carbon-Carbon Bond Formation

Cameron Paloutzian

Perhaps the most important piece of biological machinery is the ribosome. Its mechanism and flexibility allows for the precise assembly of sequence-defined polymers (proteins) by the messenger RNA (mRNA)-directed assembly and reaction of aminoacyl-transfer RNAs (tRNAs). The peptidyl transferase center (PTC) of the ribosome is its catalytic core, facilitating the formation of amide bonds between α-amino acids on charged tRNAs by bringing them into close proximity and stabilizing the intermediates that form during the course of the bond-forming reaction. Through translation reprogramming strategies, it has been shown that the PTC can catalyze reactions between monomers that are not α-amino acids to generate both esters and thioesters; these molecules have potential as sequence-defined biopolymers with applications in materials or medicine. Despite the flexibility of ribosomal catalysis, coaxing the PTC to support carbon-carbon bond formation remains an unsolved challenge. Carbon-carbon bonds are invaluable in organic chemistry because they provide a strong and flexible molecular backbone, but reactions that form these bonds usually require harsh reagents or specialized enzymes. This poster describes the synthesis and evaluation of rationally designed small molecules with the goal to discover monomers with carbon-carbon bond forming capability within the ribosome's PTC. We have generated a selection of monomers with variable carbon nucleophiles, sidechains, and flexibilities that can be acylated onto tRNAs and tested for in vitro translation. This work has the potential to introduce a whole new type of bond to sequence-defined biopolymers, allowing access to exciting new materials and medicines not previously possible.

Cameron Paloutzian is a post baccalaureate researcher working in the Schepartz Laboratory at UC Berkeley as part of the NSF Center for Genetically Encoded Materials. She graduated from UC Berkeley earlier this year with a BS in chemical biology. Her current research focuses on the synthesis and evaluation of rationally designed monomers with carbon-carbon bond forming capabilities with the goal to coax the ribosome into incorporating a C-C bond into a nascent peptide. During her undergraduate studies, she did research in the Francis Lab at UC Berkeley, where she worked on a project to conjugate a nanobody inhibitor of KRAS to cell penetrating peptides through a tyrosinase-catalyzed bioconjugation reaction for use in protein-based therapeutics. Cameron is looking to further pursue academic research interests in the near future and is intending to apply to graduate PhD programs in this coming cycle. Cameron is an avid enjoyer of animated movies and TV shows, loves playing indie games, and was a member of the University of California Marching Band for all four years of her undergraduate career.

Poster #4

Leveraging Pre-Trained Large Language Models to Generate X-Ray Radiology Reports

Maria Clarissa Fionalita

Physicians spend an excessive amount of time on data entry tasks, which hampers patient care and research. Natural Language Processing (NLP) can streamline the creation of radiology reports, a crucial aspect of healthcare, by generating structured information from unstructured data. This study aims to ease the burden of documentation by leveraging artificial intelligence technology, specifically the pre-trained Large Language Model (LLM). The proposed method of this study involves fine-tuning language models on a specific set of X-ray radiology reports. Preliminary results from this research shows that fine-tuning language models can help reduce documentation time, alleviate physician burnout, and enhance healthcare services.

Maria Clarissa Fionalita has a Master of Science in Applied Data Science from the University of Chicago. An avid credit card points collector, her main research interest is in applying Artificial Intelligence/ Machine Learning to solve real-world business problems. When not coding, she works at UChicago Booth Roman Family Center for Decision Research lab as a Research Assistant, recruiting participants about to study human judgment and biases. She is also an experienced business consultant who has worked alongside business professionals from 40+ countries.

Poster #5

Constraining the dark matter-baryon interaction cross section using the thermodynamics of galaxy clusters

Eleanor Stuart

Non-gravitational interactions between dark matter (DM) and ordinary, or baryonic, matter have not been observed. However, many models for DM rely on some sort of interaction between baryonic and DM matter, in order to produce DM in the early Universe. Constraints on these interactions help disentangle possible DM particle models. DM models with a non-zero DM-baryon interaction cross section imply temperature exchange between DM and baryons. Galaxy clusters are the largest gravitationally bound structures in the Universe. Their mass and temperatures can be measured, so this information can be used to learn about the DM in a cluster. We present a new method for constraining the DM-baryon interaction cross section and DM particle mass for different types of interactions. Baryonic gas in galaxy clusters is heated by active galactic nuclei (AGN) feedback, the energy radiated away from the centers of galaxies. We place an upper limit on interactions by assuming thermal equilibrium of baryons which are heated by AGN feedback and lose energy to DM. By equating previously determined DM cooling and AGN feedback models, we obtain an equation for cross section in terms of DM particle mass. We obtain upper bounds for three different types of interactions for DM with particle mass less than that of a proton. We also examine the scenario of 2-component DM that is partially interacting and partially non-interacting. The initial constraints are currently weaker than those found through other methods; however improvements to our model, as well as new data expected from upcoming surveys, could improve constraints.

Eleanor Stuart is a second year physics PhD student in the University of Southern California's cosmology group. She received her Bachelor of Science in Physics from Florida Atlantic University. As an undergraduate researcher, she examined light curves of variable stars, using information about a dwarf galaxy's variable star population to calculate its distance from us. She received an honorable mention for her poster presentation on this work at the 234th American Astronomical society meeting. After graduation, she completed a post baccalaureate program at the Max Planck Florida Institute for Neuroscience, developing a machine learning tool to help neuroscientists in their data analysis which was published in Scientific Reports in 2021. Now she is developing a method for constraining properties of dark matter by looking at measurements of galaxy clusters. Growing up queer in Florida, Eleanor found community and mentorship in LGBT organizations at her university and work, and aims to give back by participating in programs that help make STEM fields more accessible and equitable for all.

Poster #6

Breaking the Silence: Exploring the Disclosure of LGBTQ+ Identities among Science and Engineering Instructors

Parth Bhanderi

While LGBTQ+ undergraduates have higher attrition from STEM majors than their straight and cisgender peers, and perceive benefits from having LGBTQ+ instructors, many instructors often refrain from coming out because they perceive limited benefits to students from doing so. This study explored the disconnect between students' anticipated benefits and instructors' hesitancy to come out by tackling two critical questions: to what extent do science and engineering instructors reveal their LGBTQ+ identities in various contexts and what factors affect their decision to reveal or conceal their LGBTQ+ identity? We surveyed LGBTQ+ science and engineering instructors at R1 institutions (N=108; 5.2% of overall sample). Participants reported whether they revealed their LGBTQ+ identities to all, some, or none of the individuals in various contexts (e.g., colleagues, undergraduates) and the reasons why they reveal or conceal their LGBTQ+ identities to undergraduates. Of all LGBTQ+ participants, 23.5% revealed their sexuality and/or romantic attraction LGBTQ+ identities whereas 26.1% revealed their LGBTQ+ gender identities to all undergraduates in their courses. The most common reason why instructors revealed LGBTQ+ identities to all undergraduates was because they wanted to be a role model for LGBTQ+ students. Conversely, instructors most commonly concealed LGBTQ+ identities was because they did not perceive their LGBTQ+ identities to be relevant to course content. Assessing the prevalence of LGBTQ+ role models for undergraduates in science and engineering provides the basis for future research assessing the impact of these role models on students.

Parth is a junior at Arizona State University pursuing a double major in Biochemistry and Philosophy. His research interests include studying the disclosure of concealable stigmatized identities in STEM academia.

Poster #7

Uncovering Metabolic Vulnerabilities of Leukemia in the Central Nervous System

Alan Yiu-Leun Wong

Although survival rates in acute lymphoblastic leukemia (ALL) have risen in recent years, ALL remains the most common pediatric cancer and 2nd greatest cause of pediatric cancer mortality. Mortality is frequently related to spread of the cancer to the central nervous system (CNS), and currently all patients receive prophylactic chemotherapy to the CNS through the cerebrospinal fluid (CSF). However, CNS-directed chemotherapy can cause neurotoxicity and have long-lasting side-effects. Up to 67% of ALL patients develop long-term deficits in sustained attention, and ALL survivors have >6 fold higher prevalence of academic and executive functioning deficits. There is a clear need for new therapeutic targets that exploit specific susceptibilities of CNS leukemia to limit toxicity. To address this knowledge gap, our goal is to identify unique molecular vulnerabilities of ALL cells in the CNS that can serve as therapeutic targets.

To address this hypothesis, I performed a 172-gene in vivo CRISPR loss of function CRISPR/Cas9-based genetic screen using a xenograft mouse model of human ALL to identify metabolic genes that are uniquely necessary for leukemia growth in the CNS. This screen revealed genes in copper metabolism (SLC31A1, GSR) and oxidative phosphorylation (SDHA) as selective dependencies in CNS leukemia cells as compared to leukemia cells in the periphery, suggesting that CNS leukemia may uniquely rely on copper metabolism to support mitochondrial respiration. The goals of my ongoing work are to: 1) investigate the potential for copper to be a limiting micronutrient for CNS leukemia, 2) assess whether leukemia cells in the CNS critically rely on oxidative phosphorylation (and if so, for what purpose), and to 3) validate the therapeutic tractability of copper metabolism in CNS ALL.

Alan is currently an MD-PhD Candidate in the Harvard-MIT Combined MD/PhD Program. Originally hailing from Vancouver BC, Canada, he began his scientific journey studying limb regeneration in axolotl as part of his bachelor's thesis in the lab of Jessica Whited at Harvard College. After completing his bachelors, he then started in the MD-PhD program and joined the lab of Naama Kanarek studying metabolic adaptation of leukemia that moves to the central nervous system. His long-term goal is to become a pediatric oncologist. Outside of research, he enjoys singing in choirs, cultivating houseplants and trying new foods.

Poster #8

How does propeller size and effort impact multi-jet propulsion in salp colonies? Speed and mobility of colonial salps by species

Kaiden Walton

Salps are a clade of marine planktonic tunicates with a dual life cycle, which includes a solitary oozoid that asexually buds colonies of genetically identical clones of sexually-reproducing blastozooids. These blastozooids are connected both physically and neurologically, and move together as a singular animal through multijet propulsion. There are seven distinct colony architectures that a colony can develop into, depending on its species: linear, bipinnate, transversal, helical, oblique, cluster, and whorl. The speeds that these colonies can achieve underwater are partially dependent on their hydrodynamic efficiency, which we hypothesize is in turn driven by size and shape of the colony. To do this, we are analyzing in situ underwater stereoscopic video footage using EventMeasure to gather data on the 3D speed of colonies and the pulse rate of individual zooids. In addition, we are using ImageJ to estimate the size of entire colonies and individual zooids. We expect that more streamlined colony architectures (such as linear, helical, and bipinnate) will be the fastest, while architectures with bulkier, less optimal frontal drag scaling designs (such as transversal, cluster, and whorl) will be slower on average. Studying salp locomotion opens understudied avenues of the biomechanics and ecology of these animals. Salp locomotion can contribute to the design of underwater robotic vehicles, in the understanding of how their colony shape affects their speed and how the individual zooids interact to move. In addition, it can provide insight into the importance of vertical migration, for predator evasion and overall mobility of varying architectures.

Kaiden Walton (he/him/his) is a fourth-year undergraduate studying marine biology and environmental studies at the University of Oregon. As a research assistant in the Sutherland Lab, he studies the locomotion and mobility of salps and participates in lab-wide research cruises that look at species diversity and abundance of gelatinous zooplankton along the Oregon coast. He also volunteers his time in the Ichthyology Collection at Oregon State University, and hopes to continue his studies in ichthyoplankton and larval fish morphology in graduate school. For the last year, Kaiden has served as president of the Out in STEM chapter at the University of Oregon and is excited to continue serving his school's LGBTQ+ STEM community. When he's not on campus, he enjoys spending time with his cat and kickboxing.

Poster #9

Synthesizing Protein Copolymers via Propagation-From with Photoinitiators

Eleanor David

Protein-Copolymer Synthesis research is gaining traction due to the need for more decomposable plastics and plastic alternatives in industry today. In my contributions so far, I have explored the viability of reacting Irgacure 2959, a known photoinitiator activated by UV light, with water-soluble proteins including Whey via one of the protein's amine groups, then photopolymerizing from the protein-photoinitiator. In addition to the use of Irgacure 2959, Benzoyl Benzoic acid was also explored as an alternative photoinitiator because it required fewer initial small molecule reactions before linkage to protein, but presents a reaction feasibility issue because of its relative insolubility in water. The small molecule reactions of the Irgacure 2959 were characterized with H-NMR Spectroscopy, and the success of both Irgacure 2959 and Benzoyl Benzoic Acid reactions with Whey protein were evaluated using SDS-Page. Research efforts are ongoing to create a viable protein copolymer from the above processes.

Eleanor David is a third-year Chemical Engineering student at Carnegie Mellon University. She is particularly interested in research, especially into the production of materials, most importantly as it pertains to renewable materials and renewable energy. She is an Undergraduate Research Assistant in Professor Daphne Chan's lab on campus, and is exploring a Nuclear Engineering Certification at the University of Pittsburgh. She also serves as the President of Out in STEM @ CMU, and sits on the Carnegie Mellon School of Engineering Diversity and Inclusion Student Advisory Board. She plans to continue work uplifting underrepresented groups in STEM in the future. Outside of classes, she is the incoming Head Mechanic for Fringe Buggy, a competitor in the annual CMU Sweepstakes Racing Competition. In addition to work in the sciences, Eleanor is studying with Professor David Harding through CMU's Engineering and Arts program for an Additional Major in Viola Performance.

Poster #10

The Effects of Inter-Core Coupling on Pulse Propagation in 6-Core Microstructure Optical Fiber

Albert DiBenedetto

We experimentally investigate inter-core coupling and picosecond pulse propagation in 6-core microstructured optical fibers. The two fiber designs under consideration have a hexagonal arrangement of cores with diameters of 3.9 μm and core separation distances of 7.6 μm and 10 μm. Optical pulses from an 8-ps, mode-locked laser are launched into a single core of the 5-m long fibers where the wavelength of 1064 nm is near the zero-dispersion wavelength of the fiber. Inter-core coupling, and spectral broadening due to self-phase modulation and four-wave mixing are observed. In this study, we perform core-dependent, power measurements and obtain optical spectra. We observe a reduction in effective nonlinearity attributed to the energy distribution among the cores which in turn reduces spectral bandwidth. Our results are important when using multi-core optical fibers as the nonlinear optical medium for applications in telecommunications and quantum optics.

Albert DiBenedetto is a PhD candidate in the Department of Physics at University of California, Merced. He is currently under the direction of Dr. Jay Sharping. Albert is a first-generation college graduate and holds B.S. and M.S degrees in physics from Ball State University. His research interests include nonlinear optics, quantum optics, and photonics. As an openly gay male, he hopes to bring visibility to LGBTQ+ scientists and demonstrate one of the many roles the queer community has in STEM.

Poster #11

Bottom-Up Doping of Sustainably Fabricated Cellulose Aerogels

Judy Ipock

Aerogels are a remarkable class of materials typically characterized by high porosity, high specific surface area, and low density. They have historically been made from a myriad of source substances like silica, organic monomers, and even transition metals. Cellulose provides an advantageous source for fabricating aerogels. The biopolymer is the most abundant on Earth, can be easily recycled through sustainable, low-cost methodologies, and provides excellent physical properties like a higher mechanical strength as compared to aerogels made from other substances. Further, cellulose aerogels' chemical and physical properties can be easily tuned to fit the desired application, like water filtration and remediation, specifically due to the highly porous nature of the aerogel. Activated carbon is an organic product known to be useful in water filtration due to adsorption of a variety of caustic impurities. In this work, we aim to incorporate activated carbon as a dopant in sustainably made cellulose aerogels to enhance the aerogels' water filtration capabilities.

Hi, My name is Judy Ipock. I am an undergraduate student at West Chester University. My major is Chemistry-Biology and I do research at the university under Dr. Abbie Ganas.

Poster #12

Deciphering sequence-to-function frameworks of engineered RNA sensors

James Robson

RNA toehold switches are engineered RNA molecules with the capacity to detect specific RNA target sequences. However, the design of toehold switches is complicated due to a multitude of factors that impact RNA function, from RNA's interactions with proteins, metabolites, and full-length transcripts, to secondary and tertiary structures that influence both translation and degradation. In this work, high-throughput studies of diverse toehold sequences targeted along a full-length transcript are performed with the goal of understanding how RNA target structure and interactions between RNAs affect function. Utilizing a novel, fully automated cloning workflow with liquid-handling robotics, direct comparisons in switch activation are made between a full-length target and a library of 36-nucleotide truncated targets tiled along the same full-length mRNA. High-performing regions and sequence motifs are identified, where switch activations exceeding fold changes of 150 are achieved. 27.5% of the library tested exhibits a reduction in switching activation between the full-length and truncated targets, reducing fold changes up to 96.6%. Through computing changes in various thermodynamic properties of the toehold region, sensor, and surrounding mRNA target nucleotides, an improved computational tool is created that results in reliable prediction of highly functional toehold switch sensors. The development and characterization of these RNA sensors and their respective targets provides a deeper understanding of RNA folding and function and the interactions that govern RNA-RNA binding, which can be harnessed for improved design of diagnostic devices and other RNA synthetic biology tools.

James Robson is a Ph.D. candidate in the Green Lab at Boston University. He obtained his B.S. in Biomedical Engineering from Boston University in 2020 where he also studied saxophone performance. With extensive experience in the development of molecular and microfluidic assays, and low-cost, point-of-care diagnostics, his research interests are focused on understanding the design of nucleic acid devices to improve global health. James has used this expertise in assay development in diverse applications, from fabricating gold leaf electrode biosensors to aiding in the buildout and integration of an automated high-throughput CLIA laboratory for SARS-CoV-2 testing. James is an NIH Synthetic Biology and Biotechnology Fellow and National Science Foundation Graduate Research Fellow. His publications bridge nanotechnology, synthetic biology, and engineering and have appeared in PNAS, ACS Central Science, and Analytical Methods. Beyond research, James is an advocate for fostering inclusive educational opportunities. Drawing from experiences within the foster care system, he channels his passion into expanding educational avenues for foster youth, especially LGBTQ+ youth. Through work with Foster Club, the State Policy Advocacy and Reform Center, and the Casey Family Foundation, James engages with policymakers to amplify the voices of foster youth, ensuring diverse perspectives are integrated in welfare policy development. A steadfast advocate of science education, James has developed curriculum and taught courses through the Technology Innovation Scholars Program and First Inspiration in Research and Engineering to local students, with an emphasis on traditionally marginalized communities. His mission to create inclusive environments for LGBTQ+ individuals in STEM is paralleled by his commitment to enhancing the education experience for all students by facilitating the Inclusive STEM Teaching Project and other workshops. James combines his research, educational commitment, and advocacy efforts to make a profound impact in the field of Biomedical Engineering and society as a whole.

Poster #13

Investigating Orbits for a Gravity Tractor Demonstration Mission

Colby Merrill

The slow perturbing approach to deflecting asteroids is a likely method to be used in a future demonstration mission. The gravity tractor is an example of a technology that uses the slow perturbing approach and is the second-most mature planetary defense technology behind kinetic impactors. A binary system is an ideal choice for a gravity tractor to demonstrate its capabilities. These systems feature a large central body and a smaller secondary body. The secondary body orbits around the primary body with a typical period of hours to days. The secondary is also particularly easy to perturb with a spacecraft because of its small mass. It is also easy to measure the change to the body's orbit because of its relatively short period. We investigate where in a binary system gravity tractors are most effective for perturbing the secondary and creating a measurable change to its orbit. We study a large trade space and use the Gauss Planetary Equations to benchmark the gravity tractor's effects on the secondary of the binary system. We find that trailing `behind' the secondary is the safest option and leading `in front of' the secondary would create the greatest change to the secondary's period. We also find that orbiting between the secondary or primary (or beyond the secondary's orbit) will not result in a large perturbation to the secondary but could be appropriate strategies for longer missions.

Colby (they/them/theirs) earned a Bachelor of Science in Aerospace Engineering from the University of Maryland in College Park in 2022. They currently attend Cornell University as a PhD student in Aerospace Engineering. They are a member of the NASA DART Investigation Team and ESA Hera Science Team. Outside of academics, they read many science fiction novels, play the guitar, and explore the outdoors (rarely all at once).

Poster #14

Towards Robotic Exoskeleton Multi-Contact Walking Via A Gait Library

Sara Frunzi

Using robotic mechanisms to restore autonomy through walking in paraplegic individuals is an active field of robotics research. Current work in the AMBER Lab has improved dynamic walking with ATALANTE, a crutch-less exoskeleton developed by Wandercraft, but only with a flat-footed model, wherein the dynamics of the foot are simplified so it can be assumed that the entire surface of the foot is coming into contact with the ground at once. This model has been useful for walking in many robots, but it makes an unnatural comparison to human-like walking and is infeasible for rough terrains. This work presents the utilization of a gait library as a step towards implementing multi-contact walking, a model which takes into account regions of the foot striking the ground in succession, as opposed to the entire foot at once. In this approach, we generate multiple gaits of several velocities using optimization functions and constraints based on physical limitations of the exoskeleton and desired traits of a gait. These gaits are stored in a library that can be accessed by the robot controller. By tracking the robot's velocity, the controller can switch to a different gait upon interference to prevent the robot from falling. Because multi-contact walking is more complex than flat-footed walking, singular gaits may be less stable for prolonged use; using a gait library addresses this stability concern. Future work on this project will incorporate user feedback to change the desired velocity and take user preferences into account.

Sara Frunzi is a mechanical and robotics engineering student at Worcester Polytechnic Institute. She is from Philadelphia, PA, and is the first one in her family to attend university. She hopes to attend graduate school to earn her PhD in mechanical engineering with a specialization in robotics. Sara has worked in research areas of medical devices, rehabilitation robotics, bipedal walking robots, and soft and underwater robots. In the future, she would like to focus on the development and applications of soft robots for environmental cleanup.

Poster #15

How LGBTQ+ Students Experience Physics Education in California

Jacob Garner

As the physics education community continues to push for more equitable classroom and academic practices, there is a need for more explicit attention to the experiences of LGBTQ+ physics students. This ongoing study strives to better understand LGBTQ+ students' experiences in college via interviews with LGBTQ+ undergraduate and graduate students across multiple higher education institutions in California. Interviews focus on students' perceptions of physics as a major for LGBTQ+ people, their support systems, and ways that their identities (LGBTQ+ and others) have affected their college careers. Preliminary results of emerging themes from interviews and potential takeaways will be shared. The emergent themes include: the importance of faculty student connections, LGBTQ+ physics students' perception of physics culture in different spaces, and the impact of intersectional identities.

Jacob Garner is a first year Graduate Student at SJSU. He is interested in the field of Physics Education Research, and seeks to make physics education more equitable. Jacob has worked with his advisors since his final year as an undergraduate student, and has even presented his work at AAPT, American Association of Physics Teachers, this summer. Jacob is excited to meet other LGBTQ+ people in STEM and, even more excited to share his team's findings.

Poster #16

New developments in micro-XROMM to assess mastication in mice

Sacha Henry Sides

X-ray Reconstruction of Moving Morphology (XROMM) uses marker-based X-ray motion tracking combined with CT reconstruction to visualize in-vivo skeletal motion in 3-Dimensional space. XROMM's utility has been limited primarily by size, with smaller animals requiring increasingly specific accommodations to achieve high-quality imaging during fluoroscopic capture. These size constraints present challenges both on the technological side— with smaller animals necessitating a micro-fluoroscopy machine to allow image and light amplification without sacrificing resolution— and also on the methodological side of requiring minimally-invasive microsurgical implantations of trackable, radio-opaque tantalum marker beads in fixed landmarks.
We describe the development of the first microXROMM study and its early application in analyzing hemimandibular kinematics during mastication in Mus musculus. Modern evolutionary theory suggests that much of mammal diversity can be attributed to early adaptive radiation of rodents, making mice a model organism for studying mammalian evolution. Mouse cranial morphology prevents simultaneous incisal and molar occlusion, resulting in a bimodal system of food acquisition and propalinal mastication that has been difficult to quantify biomechanically. We explored this system by implanting 0.25 mm tantalum markers in the cranium and hemimandibles of mice, and utilized the videofluoroscopy machines in the Keck Research Laboratory at Brown University to record quantifiable biomechanical data with a minimally invasive setup. This reveals micro-movements of small animals that previously had to be measured by proxy. This project reports defined steps in new microXROMM protocols that can be applied across taxa, overcoming a limit that has prevented the progression of in-vivo kinematic assessments in smaller organisms.

Sacha Henry is a junior at the University of Florida pursuing a bachelor's degree in anthropology. He has been involved in on-campus undergraduate research for a year and a half, using 3-D reconstruction methods and morphometrics to analyze the growth and shape of the non-human primate skeleton. This session, he is presenting research that he began at Brown University through an REU during the summer. He is interested in pursuing a Ph.D. following graduation, conducting research in comparative anatomy and functional morphology of vertebrates. Outside of research, Sacha is the Treasurer for UF's oSTEM chapter, and he is especially passionate about making anatomy and anatomy education a trans and intersex-inclusive space.

Poster #17

Unraveling Epigenetic Patterns in Juvenile Mussels: The Role of DNA Methylation and How it Drives Thermal Tolerance at the Organismal Level

Riya Belani

Climate change is influencing the frequency and intensity of extreme temperatures for organisms worldwide, but the effects are especially felt in the marine intertidal zone where organisms like Mytilus mussels already live near their thermal limits. The thermal plasticity of physiological traits like growth is well-understood in Mytilus mussels, but we understand far less of the epigenetic mechanisms underlying these traits and their inheritance. We explored whether DNA methylation levels in juvenile mussels varied between sites with different thermal variances in an intertidal zone at the Hopkins Marine Station in Monterey, CA. Juvenile mussels were exposed to protected (warm) and exposed (cool) wave conditions in a field acclimation experiment. Previous studies from this experimental design showed higher growth rates and survival in exposed (cool) juvenile mussels after one month.
In this study, gill tissue was collected from these same individuals to undergo reduced representation bisulfite sequencing (RRBS) to evaluate methylation at CpG islands in the genome. We quantified, visualized, and compared DNA methylation profiles between the treatment conditions using Bismark and MethylKit. Global methylation levels were not significantly different between the cool and warm sites, however, we found some patterns related to genes involved in key cellular stress pathways and growth. This research is a first investigation into the role of epigenetic modifications that influence physiological tolerance under heat stress in highly dynamic environments.

Riya Belani is a fourth-year Health Sciences major with a Sociology minor who is passionate about Public Health and Ecology and is hoping to pursue a Ph.D. post-graduation. Outside of the classroom, she is heavily involved in activism through her university's Student Government Association and through various clubs such as Chapman Feminists and the South Asian Student Association. Overall, she aims to use science to combat social inequities and advocate for all communities.

Poster #18

Immune cells of salivary gland utilize TNF signaling to promote growth during development

Henry Weith

Salivary glands (SG) are essential to maintain the health of the oral cavity through the production and secretion of saliva. Irreversible damage to SGs by irradiation treatment can produce chronic dry mouth, a debilitating syndrome that reduces oral health and quality of life. Utilizing SG development as a model has revealed many key components of tissue morphogenesis that can be leveraged for SG regenerative approaches. Reparative roles of immune cells have been defined in many organs, yet there is little research that considers immune cells in SG regeneration. Here we define the emergence of specific immune cells during early embryonic SG development at a critical time point during branching morphogenesis and secretory cell specification. Single-cell analysis of embryonic SGs identified significant communication between immune and epithelial cells via the TNF signaling pathway. Immune cell populations specifically expressed Tnf, and paracrine signaling to the SG was determined via the TNF receptor 1 (TNFR1), expressed by epithelial cells. Using an in vitro explant culture system, we define a role for TNF in early SG expansion with TNF promoting proliferation in both endbud and ductal cell compartments. Loss-of-function experiments find TNF inhibition reduces gland branching and endbud clefting. Our results indicate that SG development may be regulated by immune cells, and that TNF signaling plays a morphogenic role in epithelial branching morphogenesis.

Henry graduated from Northeastern University in 2022 with a bachelor's degree in Bioengineering. During his undergrad he explored various types of research including mitochondrial population dynamics, genetics of wing patterning in butterflies, fluid dynamics of biomedical devices, and cancer immunology. Currently, he is a second-year PhD student in the Developmental, Regenerative, and Stem Cell concentration of the Biomedical Sciences program at Mount Sinai. He works in Dr. Ali May's lab studying the development of exocrine glands in mice and humans. Outside of lab Henry enjoys reading, visiting art galleries, running, and techno.

Poster #19

Elucidating the Reversion Mechanism of Donor-Acceptor Stenhouse Adduct (DASA) Photochromic Molecules

Aurora de Tagyos

Donor-acceptor Stenhouse adducts (DASAs) are a class of visible light-activated photochromic molecules. These molecules are composed of three elements: an electron donor, a triene backbone, and an electron acceptor. Upon activation, they transform from a colored “open” form to a colorless “closed” form with different properties. These molecules have found applications in photothermal agents, amine sensing, and photopharmacology. DASAs have a thermal equilibrium between their open and closed forms and have been observed to favor the closed form in polar solvents. It is possible to adjust this equilibrium by attaching a methyl group to the triene but then a reversion to the DASA starting materials is observed. This reversion is studied in various conditions using UV-Visible spectroscopy (UV-Vis) and Nuclear Magnetic Resonance (NMR) techniques to gain a better understanding of the general reversion mechanism. It has been observed that these DASAs break apart and recombine with each other in a dynamic exchange equilibrium. This is leading to further investigation regarding the feasibility of DASA incorporation into covalent adaptable networks.

Aurora de Tagyos is a 4th year Chemistry and Biochemistry major in the College of Creative Studies at the University of California, Santa Barbara. She has been an undergraduate researcher for two years and works in two different research labs at UCSB. She is also a 2023 Beckman Scholar which supports her main research project. When she isn’t in the lab or doing homework, Aurora loves hiking, photography, and cross stitching.

Poster #20

Effects of Chronic Oral THC Consumption on Cognition in Young and Aged Rats

Natalie Barber

Older adults are the fastest-growing group of cannabis users in the United States. Cognitive functions supported by the prefrontal cortex (PFC) and hippocampus (HPC) are impaired in aged relative to young subjects. Some aspects of cognition are also impaired by chronic consumption of delta-9-tetrahydrocannabinol (THC, the primary psychoactive component of cannabis) in young subjects; however, effects in aged subjects have been understudied. The goal of this study was to determine whether the cognitive effects of chronic THC consumption differ across age, sex, and cognitive domain using a rat model. Male and female young adult (6 mo.) and aged (24 mo.) Fischer 344 x Brown Norway F1 hybrid rats were tested on a PFC-dependent delayed response working memory task and a HPC-dependent trial-unique non-match to location (TUNL) task. A randomized, within-subjects design was used such that each rat consumed gelatin with or without THC daily for three weeks after testing in either the HPC- or PFC-dependent tasks each morning. In the PFC-dependent delayed response task, aged control rats failed to improve performance from baseline over three weeks of testing whereas aged THC rats significantly improved performance. Preliminary data shows that in the HPC-dependent TUNL task, control and THC rats had no differences in performance across age or sex. However, young THC rats failed to improve performance from baseline to three weeks on 5 degrees of separation. When considered together, these results suggest that chronic THC consumption has age- and cognitive domain-dependent effects on cognition.

Natalie Barber (they/she) is a senior undergraduate student at the University of Florida pursuing a B.S. Psychology and B.S. Biology with a minor in health disparities in society. They work as a research technician at the McKnight Brain Institute under the direction of Dr. Setlow and Dr. Bizon. With their mentorship, Natalie has been able to conduct research investigating the effects of chronic THC consumption on cognition in the context of aging and was awarded a University Scholars Program grant to continue their work in this topic. In addition to their research, Natalie is the president of the Out in Science, Technology, Engineering, and Mathematics chapter at the University of Florida and a recipient of the University of Florida LGBTQ+ Alumni Association scholarship for their efforts in promoting LGBTQ+ professional development and community building at the University of Florida. Natalie plans to pursue a PhD in Clinical Psychology after graduating from the University of Florida in Spring 2024, through which they hope to continue conducting research in psychology and promoting LGBTQ+ interests.

Poster #21

Discovery and Validation of Biomarker Candidates from the Senescence-Associated Fibroblast Surfaceome

Thedoe Nyunt

Cellular senescence is a multifaceted stress response characterized by permanent cell-cycle arrest and a pro-inflammatory secretory phenotype. Given that senescent cell accumulation underlies aging-associated pathologies, including neurodegeneration and diabetes, selectively eliminating senescent cells is a promising therapeutic approach for these diseases. However, deeper knowledge of therapeutic targets and biomarkers to assess senescent cell burden in humans is needed. Here, we employ quantitative proteomics to identify and prioritize senescence-associated fibroblast surface proteins (the "surfaceome") and orthogonally validate biomarker candidates using flow cytometry.

Senescence was induced in human IMR-90 lung fibroblasts by exposure to 15 Gy of ionizing radiation. After 10 days, senescent and quiescent control cells were collected for Glyco-Cell Surface Capture labeling and proteomic LC-MS/MS analysis. Proteomic data were acquired using the Q-Exactive HF Orbitrap mass spectrometer through variable-window Data-Independent Acquisition (DIA) and analyzed using Spectronaut software. Candidates were prioritized for further analysis based on fold change magnitudes, false discovery rate, replicate reproducibility, and presence of N-glycosylation sites. Surface expression of selected candidates was measured via flow cytometry on the BD FACSymphony A3 Cell Analyzer and analyzed using BD FACSDiva and FlowJo software.

Proteomic analysis identified 3880 peptides corresponding to 1335 proteins, of which 974 peptides and 420 proteins had computationally validated N-glycosylation sites. Among the 148 differentially expressed proteins, we filtered for 16 protein candidates that were upregulated in senescent fibroblasts and were known cell-surface proteins. We highlight 2 candidates from this dataset (CDCP1 and PAR1), along with 3 previously studied markers (CD44, VCAM1, and DPP4), whose senescence-associated overexpression was validated via flow cytometry. These results demonstrate the utility of developing surfaceome biomarkers through mass spectrometry-based proteomics to phenotype senescent cells. Ultimately, this study may provide valuable clinical insights for the advancement of senescence-targeted therapies aimed at mitigating chronic inflammation and age-related diseases.

Thedoe Nyunt (he/him/his) is a Postbaccalaureate Intramural Research Training Award (IRTA) Fellow at the National Institute on Aging (NIA) in Baltimore, Maryland. He received his Sc.B. in Biochemistry in 2022 from Brown University, where he explored the role of protein tyrosine phosphatase SHP2 in chondrocyte homeostasis with Dr. Wentian Yang. Thedoe's current research is under Dr. Nathan Basisty at the NIA, using mass spectrometry-based proteomic workflows to identify and develop novel senescence-associated biomarkers and targets for aging-related diseases. Thedoe aspires to become a physician-scientist and leverage both science and medicine to advance human health. As a gay man and a queer person of color, he hopes to continually center the health needs of the LGBT+ community and other marginalized identities through his career in academic medicine. Thedoe is excited to meet others with similar goals and learn how scientific and queer communities can mutually support each other.

Poster #22

“That; that’s Chaos Theory”: Stabilization of Periodic Orbits of the Stochastic Logistic Map

Haley Lorenz

Chaotic systems have garnered increasing importance in diverse scientific disciplines due to their complex behavior and sensitivity to initial conditions. In this poster, we explore the effects of perturbing chaotic systems with noise, which introduces a controlled degree of randomness. Specifically, we investigate the renowned logistic map, represented by $\lambda x(1-x)$, where the parameter lambda varies within the range of 0 to 4.

Our primary focus is on varying the lambda value with each iteration of the logistic map according to different distributions. By applying this stochasticity, we seek to demonstrate the convergence of distinct initial x-value distributions, encompassing both discrete and continuous cases, towards similar-looking distributions over time when subjected to the same continuous lambda distribution.

Through our investigation, we shed light on the influence of lambda distribution on the long-term behavior of perturbed chaotic systems. These findings offer valuable insights into the understanding of chaotic dynamics and may have implications for various applications in fields such as physics, biology, and engineering.

My name is Haley Lorenz, and I’m an undergraduate researcher at CSUSM. My journey in academia began at MiraCosta College, where I earned my associates in Mathematics and Science before transferring to Cal State San Marcos (CSUSM) in 2022. It was at CSUSM that I got the incredible opportunity to participate in the Summer Scholar program under the guidance of Dr. Kimberly Ayers. During the Summer of 2023, our research team delved into the fascinating world of chaos theory. Exploring the intricacies of chaotic systems and their behavior was both challenging and exhilarating. As someone deeply passionate about mathematics, this research was an ideal fit for me.

Beyond my academic pursuits, I have a profound love for my hometown of Oceanside and the beach, which has always felt like home. I find joy in performance arts and playing the ukulele. When I’m not immersed in my studies, you can often find me paddleboarding with Gemma, my beloved dog.

Currently, I am actively involved in yet another research project that involves running simulations for a wave energy harnessing device to power a car battery, led by Dr. Hammed Nademi. Looking ahead, I aspire to complete my Bachelor of Mathematics degree with a concentration in Algorithmic Mathematics in May 2025. With this background, I plan to pursue a career as a data scientist or data analyst, leveraging my passion for mathematics and research.

Poster #23

Proteins as Renewable and Biodegradable Fillers in Polymer Composites

Abigail Umscheid

Fillers are finely divided and particulate materials that are dispersed throughout a polymer matrix to control polymer characteristics, such as mechanical and physical properties, general and thermal stability, and weight. The addition of fillers lowers the production costs associated with producing polymers, making their use ideal for the mass production of composite polymers. Many fillers currently used are derived from fossil fuel sources that negatively impact the environment. This study proposes that whey protein fillers may offer a more environmentally friendly alternative, however, the proteins are partially hydrophilic, meaning that they do not mix well with hydrophobic polymers. To overcome this, the proteins will be denatured, allowing for more hydrophobic aggregates to be formed through hydrogen bonding. It is through the protein's high affinity for hydrogen bonding that secondary structures, such as beta sheets, could be formed. These such structures, when properly dispersed throughout a polymer matrix, would introduce high mechanical strength ideal for reinforcing composites. The presence of secondary structures will be measured through Fourier Transform Infrared Spectroscopy and Thioflavin-T Fluorescence to quantitatively determine the efficacy of the modification techniques. A melt blending approach will be used to ensure the dispersion of the protein filler within polymers, and the product will be tested on its mechanical and tensile strength.

Abigail is an undergraduate junior at Carnegie Mellon University, from Pittsburgh, Pennsylvania. She is majoring in Chemical Engineering with a Minor in Biomedical Engineering. She currently serves as the secretary on the executive board for CMU's chapter of oSTEM, as well as the Vice President of Public Relations for CMU's Kiltie Band.

Poster #24

Nanoparticle-derived superamphiphobic coating-material combination for potential antimicrobial applications

Kathleen Trang

Healthcare-associated infections (HAIs) affect 1 in 31 patients daily, costing US hospitals an extra $28.4 billion annually [1]. Procedures involving blood-contacting devices, such as catheters and implants, significantly increase the risk of both HAI contraction and thrombotic complications [1]. Slippery hydrophobic surfaces have shown potential in reducing bacteria and fibrinogen adhesion [2] and have since been paired with nitric oxide (NO) donors to enhance antifouling and bactericidal capabilities. However, superamphiphobic surfaces have yet to be explored, primarily due to their non-biocompatibility and instability on polymer surfaces. Thus, we propose a versatile, antifouling, biocompatible, superamphiphobic coating for use in a dual-action antibacterial material-coating combo for blood-contacting devices. Featuring an active material and passive coating, a poly(dimethylsiloxane) (PDMS) film is swelled with S-nitroso-N-acetylpenicillamine (SNAP), a NO donor catalyzed by light, heat, and metal ions, chosen for its broad-spectrum bactericidal properties and ability to disperse and prevent biofilms [3,4,5,6]. Films are subsequently dip-coated in with silane-modified ZnO and SiO2 nanoparticles and microparticles, forming a superamphiphobic, antifouling, hierarchical nano-microstructure coating [7]. ZnO + SiO2 coated PDMS exhibits remarkable superamphiphobic characteristics, maintaining high water and n-hexadecane contact angles in experiments evaluating wettability and coating adhesion strength. Coated samples also leached significantly less SNAP than uncoated samples, displaying a burst release profile where average NO flux was significantly higher than that of SNAP-PDMS on day 0. In this work, we exhibit the superamphiphobic properties of a ZnO + SiO2 nano/microstructure coating in conjunction with a SNAP-swelled material, proposing a compelling methodology to reduce HAIs and thrombosis in blood-contacting medical devices. Notably, the ZnO + SiO2 coating individually exhibits stability in a variety of scenarios, and its superamphiphobic property is independent of the base material. The coating stability demonstrated with PDMS, which is often challenging to coat, suggests a broader and more stable applicability to other materials.

This material is based upon work supported by a National Science Foundation Research Experiences for Undergraduates (REU) site program under Grant No. 1950581.

I am a 4th year biomedical engineering student with diverse research experiences in computational biology, computational genomics, biomaterials, and medical device design. I'm passionate about solving real-world problems, fostering interdisciplinary collaboration, and quantifying data for efficient communication within and beyond the scientific community. Beyond research, I'm dedicated to advocating for underrepresented groups in STEM and LGBTQ+ organizations at the University of Florida. I run the queer hiking club on campus, work with the Queer Asian Pacific Islander Desi (QAPID) discussion club, and play badminton with the UF collegiate team. When I'm not in the lab, you can find me taking a spontaneous road trip to the west coast for a night of stargazing, listening to The Crane Wives, or liking every picture of a lizard or bird that comes across my screen.

Poster #25

Constraining SN 1987a Explosion Models With Photons & Neutrinos

Levi Webb

Current simulations of core-collapse supernova (CCSN) explosions are not able to unambiguously reproduce observed light curves from Type II SNe. In order to address this problem and better understand the mechanisms of SN explosions and their progenitors, we present new models of SN 1987A based on a physically accurate explosion model using realistic initial conditions. We use a state-of-the-art 1D code for neutrino-driven CCSNe, SN Turbulence In Reduced-dimensionality (STIR; Couch et al. 2020), to simulate stellar core collapse and explosion in blue supergiant progenitors from Menon and Heger (2017). Using output data from STIR, we generate model bolometric light curves with the SN Explosion Code (SNEC; Morozova et al. 2015). We model neutrino emission with SN Observatories with GLoBES (SNOwGLoBES; Migenda) to predict observable neutrino count rates and spectra. The results from SNEC and SNOwGLoBeS are compared to existing observational data of SN1987A to assess the ability of our numerical models to match the actual observations of SN 1987A. We also compare our results to existing models of SN1987A and other SNe.

Levi Webb is a senior undergraduate student at Michigan State University with dual majors in astrophysics and anthropology. On campus, Levi works in computational stellar astrophysics with a focus on supernovae, observational astronomy with a focus on exoplanets and novae, and historical archaeology with a focus on MSU campus heritage and WWII Japanese internment in Kooskia, Idaho. Part of Levi's observational work includes leading public nights at the MSU Observatory. He has developed a passion for talking to public audiences about astronomy, resulting in a public presentation at the Lansing chapter of Astronomy on Tap in September and an aspiration to give another this spring. Levi is also involved in multiple clubs on campus, including MSU Rocketry. In his free time, Levi explores every hobby known to man, but particularly enjoys kayaking, boxing, playing guitar, board and card games, and hanging out with his ball python.

Poster #26

Developing a Simulation for Re-Programmable Magnetically Self-Folding Origami Structures

Lily Brenner

By taking a magnetic material and cutting creases into it, we can create foldable magnetic structures, which can be programmed to have a particular polarity pixel-by-pixel. By combining certain crease patterns with certain configurations of polarities, we can create sheets of magnetic material that will automatically fold into a given shape when an external magnetic field is applied. This has far-ranging applications in various fields, with the possibility of bringing unassembled magnetic structures into space and assembling them using strong magnetic fields, or inserting structures into the human body and actuating them using an external magnetic field, which removes the need for bulky and complex electronics inside the human body. However, the manufacturing and testing process for these magnetic structures is relatively slow, which limits the speed at which further research can be done. In response, this project aims to develop a novel simulation, which will allow the folding behavior of these structures to be simulated rather than physically tested.

Lily Brenner is a sophomore studying Computer Science at the University of Pennsylvania. Lily is the President of UPenn's oSTEM chapter and a member of Penn Electric Racing, where she programs embedded systems for an FSAE racecar. Lily also volunteers as an EMT with UPenn's Medical Emergency Response Team. In her free time, Lily enjoys reading fantasy novels and playing acoustic guitar.

Poster #27

Towards standardized data collection methods for early epidemics: a scoping review

Emma (Chang)-Rabley

Well-designed observational studies have tremendous capacity to improve early epidemic response because of the speed at which they can be initiated, low participant risk, and potential to contribute large amounts of pooled data. Currently, no widely standardized protocol exists for non-randomized observational data collection during early epidemics. This lack of consistency leads to variable quality data that still often influences larger clinical trials or public health policy due to the absence of more rigorously collected data. Standardized observational study methods would improve our understanding of early epidemics, empowering public health officials and communities to respond more effectively and equitably.

To better understand the current landscape of data collection early in epidemics, we are conducting a scoping review to map and characterize methods that were employed during outbreaks of SARS-CoV-1, H1N1, Zika Virus, and Ebola from 2000-2019. We are evaluating peer-reviewed literature in any language, reporting primary research using non-randomized study designs that were published in the first 12 months from an outbreak's start date (as defined by the WHO Emergency Disease Outbreak Network). Two authors will review each abstract in the software Covidence, and discrepancies will be settled by a third reviewer. From each included paper, we will extract details about study design, quality, and timing of reported evidence. We will explore existing tools for quantifying the risk of bias in each study, and plan to identify potential areas for improvement. We hope to quantify the policy and community impact of the data reported in these studies. Our current aim is to comprehensively understand how data was collected, its quality, and its impact early in these selected epidemics.

Emma is a second-year post-baccalaureate research fellow at NIAID, the National Institute of Allergy and Infectious Diseases. In the Epidemiology and Data Management Unit, they work with Dr. Ricotta on projects in epidemiology and research methods. Currently, Emma is working on a mixed methods study to evaluate and quantify previous observational data collection methods during 4 major global outbreaks. They are broadly interested in climate change & health/planetary health, global health systems and metrics, and infectious disease epidemiology. Emma will apply to MPH/MSc programs this fall.

Poster #28

Quantum Advantage in Two-Photon Absorption: Computational Investigations of Molecules and Materials

M Wittkop

As quantum information science grows and drives new technologies, it becomes useful to consider new and innovative ways to introduce quantum effects to systems. Adding these quantum effects to a molecular system also introduces the quantum advantage - enhancement of some physical property due to quantum effects in the system. This work focuses on quantifying the quantum advantage due to different types of quantum light - entangled photons, qubit-like color-superimposed photons, and combinations thereof. It is shown that there are significant quantum advantages to using these types of photons, and that constructive and destructive interferences are present, leading to possibilities for a quantum 'switch'. The quantum advantages shown in our computational studies could be confirmed spectroscopically and the theory can be modified for material systems of interest, such as quantum dots or nanomaterials.

M Wittkop is a 3rd year PhD in Chemistry at Montana State University studying quantum science and theoretical chemistry. They are an oSTEM, Inc volunteer, the President of the MSU Graduate Employee Organization, and a queer voice for their church. In the free time those things leave, they like to game, read sci-fi, and play D&D.

Poster #29

Quantified Effect of Taconite and Precious Metal Mining on Wild Rice Watersheds of Eastern Minnesota

Nick Salgado-Stanley

Industrial activities in northern Minnesota, particularly the taconite and proposed precious metals mining in the 'Iron Range,' release chemicals that can harm native plant growth. Specifically, pollutants from the extraction of iron ore have released water that can harm wild rice (Zizania palustris) due to high amounts of sulfate entering lakes and streams where wild rice has historically grown. For centuries, wild rice, or manoomin in the local Ojibwe language, has been a staple diet for Minnesota's Indigenous people. Domestic cultivation and combined harvesting of wild rice are relatively new technologies; wild rice is grown commercially as a field crop on around 20,000 acres in Minnesota.

This study aims to quantify sulfate pollution entering Minnesota watersheds from the most impactful point dischargers. To develop a process for evaluating the magnitude of contamination from different sources, two ~7500 km2 watersheds are compared. The St. Louis River basin is directly downstream from the largest mines in the state, including the Hull-Rust Mahoning Mine which adds water containing at least 800 mg/L of sulfate to tributaries of the St Louis River. In contrast, the Upper Mississippi headwaters has few industrial polluters. Specifically, sulfate was measured at the points of discharge across the two HUC8s. This study determined that it is impossible to operate precious metal mining at the scale the Iron Range is known for while polluting under the State of Minnesota's regulations for the health of manoomin.

Nick is a fourth-year undergraduate student pursuing degrees in wildlife conservation and economics at California State Polytechnic University, Humboldt. He plans to use both natural and social sciences to devise plans to address the many issues encompassed by intersectional environmentalism. To begin this journey, he has been graced with the opportunity to be a part of the Research Experience for Undergraduates on Sustainable Land and Water Resources (REU-SLAWR) where he independently conducted research on how industrial mining impacted Minnesota's native resources, specifically wild rice (manoomin).

Poster #30

Investigating Mental Health Outcomes for Informal Caregivers Before and During the COVID-19 Pandemic

Brina Ratangee

The World Health Organization reports that the COVID-19 pandemic has triggered a 25% increase in depression and anxiety worldwide. This study hypothesizes that informal caregivers were at a higher risk of adverse mental health outcomes. Informal caregivers, especially those who care for vulnerable older adults, were likely to be at least temporarily disconnected from the individual and community resources they rely on for assistance, such as respite services and social support; leisure time for personal interests; and medical service providers available to work directly in-home. The lack of services and support translates to a greater probability of stress, caregiving burnout, and intrapersonal conflict. This study also hypothesizes that informal caregivers for individuals with Alzheimer's disease and related dementias (AD/RD) were at an especially high risk of adverse mental health outcomes due to high-intensity caregiving.

BRFSS caregiving data was used in these analyses, with outcome variables of number of poor mental health days, any number of poor mental health days, and frequent (>14) poor mental health days per month. Analyses controlled for sex, age, race/ethnicity, marital status, household size, education, income, employment, census region, and self-rated health. Ordinary least squares and logistic regression models were conducted for mental health outcome variables.

The AD/RD caregiver population was older, more educated, and higher-earning than non-AD/RD caregivers, as well as reported better self-rated health. Results indicated that providing informal care for a person with AD/RD was associated with a higher number of poor mental health days and experiencing at least one poor mental health day per month in fully adjusted models. Notably, AD/RD caregiver status was not associated with frequent poor mental health, and the disparities before and during the pandemic were not significant different — the magnitude of disadvantage for AD/RD caregivers did not disproportionately increase during the pandemic.

Brina Ratangee (she/her) is a third-year Cornelius Vanderbilt Scholar at Vanderbilt University majoring in Medicine, Health & Society (MHS) and Neuroscience. She conducts research on AD/RD caregiving burden at Vanderbilt's Center for Research on Inequality and Health, as well as on neighborhood disadvantage and other modifiable AD/RD risk factors at the Vanderbilt Memory and Alzheimer's Center. Outside of research, Brina serves as News Editor of The Vanderbilt Hustler. After graduating, she hopes to complete Vanderbilt's 4+1 Master's program in the Social Foundations of Health and subsequently attend medical school. She envisions a career that lies at the intersections of medicine, health policy, and journalism-based advocacy.

Poster #31

Canned Tuna Species Identification using PCR based Methods

Denise Hernandez

Seafood fraud occurs when products are mislabeled or substituted with a different species than what is stated on the label. Mislabeled products can pose significant health risks due to allergies and mercury levels. The problem lies in the difficulty of visually identifying canned products due to the high level of processing the fish undergoes. Theoretically, you should be able to rely on the label but that is not always the case. In our lab, we are working on PCR-based solutions that will ensure the accuracy of canned tuna labels.

Denise Hernandez is an undergraduate student at Santiago Canyon College pursuing a degree in Biotechnology. She has also obtained certifications as a lab technician and is completing an additional certification for QA/QC microbiology. Her research was done at Chapman University in food science under Dr. Rosalee Hellberg as part of the SURFEES program.

Poster #32

Ultrafast Photonic Quantum Information Processing

Elina Sendonaris

Quantum information processing (QIP) offers significant advantages in computing, sensing, and communication. Integrated nonlinear photonics has been shown to be an advantageous platform for generating, manipulating and measuring quantum information given the inherently broad bandwidth offered by propagating light. We demonstrate how nanophotonic platforms with a strong second-order nonlinearity are used to accomplish these tasks in an ultrafast operation regime, enabling THz clock rates for time-domain multiplexed QIP. Specifically, we show how squeezed light is produced and measured using nonlinear devices. We then discuss how parametric and non-Gaussian processes are used to create, modify, and detect quantum states of interest to facilitate secure communication, enhanced sensing precision, and quantum computation.

Elina is a 3rd year graduate student in Applied Physics at Caltech studying nonlinear quantum photonics. She works on both theoretical and experimental applications of nonlinear photonics to creating, manipulating, and measuring quantum states using lithium niobate chips operating in the ultrafast regime. She received her BS from MIT in Physics and interned at PsiQuantum, an optical quantum computing startup, and did theoretical X-ray nonlinear optics research in between undergrad and grad school. In her spare time she loves hiking and climbing, and she's helping organize the graduate and postdoc union.

Poster #33

Three Dimensional Ceramic Architectures with Micro-Scale Resolution and Near-zero Shrinkage via Aerosol Jet 3D Printing

Caitlyn Santiago

Three-Dimensional (3D) ceramic micro-structures are important for a variety of technological applications. In this project, we explored the challenges associated with effectively fabricating these ceramic micro-structures and sought to combat these challenges by using aerosol jet printing technology. Some of the challenges associated with manufacturing these precise micro-scaffolds is due to an inability to fabricate without sacrificial materials and with a low shrinkage percentage.With this technology, using a binder free ZnO nanoparticle ink, we were able to fabricate structures with feature sizes in the range of 30 micrometers using no supports with shrinkage of 2-5%. In addition, these structures show a significant increase in ductility when compared to bulk ceramics. This research broadens our ability to design and manufacture high-performance ceramic devices in multiple areas including biomolecule sensing, tissue regeneration, catalysis, and filtration.

Hello! My name is Caitlyn Santiago, I am a current junior studying Material Science and Engineering and Biomedical Engineering. My special interests lie in applications of additive manufacturing in orthopedic implants. I have had the opportunity to explore the topic of additive manufacturing in depth through research. At the Panat Lab, I utilized scanning electron microscopy to take detailed images of 3D printed micro-lattices, research that ultimately contributed to a paper that is in preparation. I have then applied methods of additive manufacturing to the generation of collagen channels in my current lab, the Cook Lab. These contribute to the testing of oxygen exchange in artificial organs.

In addition to the academic interests I have, I am passionate about and advocate for Diversity, Equity, and Inclusion initiatives. As a part of the DEI Committee of the Biomedical Engineering Department, I acted as a liason between students and department leaders and advocated and proposed solutions to address the needs of marginalized groups. I continue to advocate for equitable admission in the Office of Undergraduate Admissions.

Poster #34

Probing Dark Matter Subhalo populations through weak lensing and astrometry

Dimple Sarnaaik

Dark matter (DM) exists in the form of large halos. These halos have gravitationally bound clumps of DM that are categorized as subhalos. We have currently no confirmed interactions between DM and normal matter other than through its gravitational effects. Here we examine one particular gravitational effect: weak gravitational lensing through astrometry in the Milky Way galaxy. Gravitational lensing is the phenomenon where massive objects warp the fabric of spacetime around them. When light passes through this curved spacetime near a massive object like galaxy clusters, its path is bent, resulting in a change in the apparent position of distant objects. Weak gravitational lensing effects are small distortions of starlight in our path due to relatively less dense objects, like DM subhalos. Here, astrometry, the precise measurement of star positions over long periods of time is used to account for the change in apparent star positions and accelerations due to DM subhalos. DM subhalos are characterized by their mass profile and mass function, which describe the mass distribution in a subhalo and their abundance in a particular volume of the Universe respectively. This work contributes to an existing DM subhalo lensing code by adding mass functions to represent the subhalos more accurately. This code will sample the observed sky from existing or future (e.g., the Nancy Grace Roman Space Telescope) survey data. Using Markov Chain Monte Carlo sampling to determine the changes in the accelerations of the observed stars given various DM models, we can identify the specific mass function and/or mass profile that is preferred by the data. This could provide us with information about DM subhalos and, in turn, properties of DM.

Dimple Sarnaaik is a third-year Ph.D. candidate at the University of Southern California, where she previously completed her undergraduate studies, majoring in Physics/Computer Science with a minor in Astronomy. Currently, under the mentorship of Dr. Kris Pardo at USC, her research centers on the probing of dark matter subhalo populations, employing astrometry to unveil their gravitational lensing effects. In parallel, she collaborates with Dr. Andrew Benson at the Carnegie Observatories, aiming to enhance the alignment between merger trees derived from N-body simulations and those created analytically using Galacticus, an open-source galaxy formation modeling code. Beyond her research pursuits, Dimple is deeply committed to science communication and promoting equity in STEM fields. As the President of the Graduate Association of Students in Physics, she actively advocates for the fair treatment of all graduate students and plays a vital role as the graduate representative in the department's climate committee, dedicated to evaluating and addressing the department's inclusivity and diversity initiatives.

Poster #35

A Software Suite for Validation of X2O Board Performance

Jessica Williams

As the Large Hadron Collider (LHC) undergoes upgrades to increase luminosity, its detectors will need faster data processing and improved electronics. The X2O is a custom electronics board to support operations in the Endcap Muon System of the Compact Muon Solenoid experiment (CMS). It has a power module, a FPGA, and 120 high speed optical links to receive, process, and communicate data.

When the design of the X2O is fully validated, the boards will go to be manufactured and each board will need to be thoroughly tested to meet the design specifications. A software suite was created to test the X2O. It analyzes physical characteristics like voltage, temperature, power, and current. It also checks programming the FPGA, reading and writing register values, and the reference clock frequencies. Operating parameters were almost all within ranges, and the X2O is ready to move to production. Future work should center around tightening performance bounds, and testing the X2O at other places in the data path it will be implemented.

Jessica Williams is a senior computer scientist and mathematician at Texas A&M interested in quantum computing. Their past work is primarily on radiation-hard edge computing in satellite and high-energy physics domains. They are passionate about theoretical computer science and quantum algorithm development. Outside of academic pursuits, they work to improve housing policy and strengthen community leadership. They also like to play board games and listen to musicals.

Poster #36

Fractionation of Birch Bark Extract for the Optimization of Naturally Occurring Medicinal Properties

Sarah Titcombe

Birch bark has been used in cultures around the globe for medicinal purposes. In particular, rich knowledge of it exists in Atlantic Canada by the indigenous Mi’kmaq people. One traditional Mi’kmaq remedy utilizing paper birch is maskwio`mi, an extract produced from the bark in a fire pit method. This has been used as a skin ointment to alleviate a variety of skin issues such as eczema and psoriasis, and interest in understanding the extract’s chemical makeup and resulting antimicrobial properties has arisen due to its high anecdotal praise. However, preliminary results show the extract contains a complex organic matrix of over 200 compounds. Therefore, fractionation by column chromatography has been applied to the birch bark extract obtained via a standardized torrefaction process to better qualify and quantify these compounds. Furthermore, testing of the resulting fractions for their inhibition against E. coli and S. aureus have given insight into which compounds show greatest antibacterial properties. Further work to identify and quantify compounds in the total extract, as well as to test the effects of fractions on skin cell proliferation, will be done to better understand the necessary concentrations of active compounds to achieve desired dermatological effects.

Sarah Titcombe is an undergraduate student at Occidental College majoring in biochemistry on the pre-medicine track. She works as a research assistant in Dr. Emmanuelle Despagnet-Ayoub’s lab associated with Occidental College and NASA-JPL, and she recently completed an internship at Cape Breton University with Dr. Matthias Bierenstiel through Fulbright-Mitacs Globalink. Outside of her studies, Sarah serves as a tutor for General Chemistry, a liaison for the Chemistry and Biochemistry department, a field captain for her rugby team, a VMA for the Alpha Chi Sigma Beta Mu chapter, and the Elections Chair for her student body government. Additionally, Sarah volunteers with Boundless Brilliance to close the gender-gap in STEM and Huntington Hospital in Pasadena.

Poster #37

Acetaminophen Modulates Functional Expression of Breast Cancer Resistance Protein at the Blood- Brain Barrier: Implications for CNS Drug Delivery

Bobby Betterton

Background: Previous work in our lab has shown that chronic exposure to acetaminophen (APAP; Tylenol®), both at therapeutic doses and at high doses, can modulate blood- brain barrier (BBB) integrity. Of note, high-dose APAP has been shown to increase CNS exposure to opioid analgesic drugs such as codeine. Since APAP is one of the most commonly used pain and anti-fever mediations in the United States, drug-drug interactions resulting from its overuse or misuse can have serious implications for pharmacotherapy.
Aim: To determine whether changes in BBB efflux transporters following acute or chronic APAP administration can affect CNS uptake of small molecule drugs.
Method: Female Sprague Dawley rats (3 months) were given either a low (80 mg/kg, i.p), medium (230 mg/kg, i.p), or high (500 mg/kg, i.p) APAP dose over a 3-hr, 3-day, 7-day or 14-day treatment course. Following the last day of dosing, cortical microvessels were isolated and used to assess changes in protein expression of P-glycoprotein (P-gp) and Breast Cancer Resistance Protein (Bcrp), two critical BBB efflux transporters, via western blot immunodetection. Ex vivo transport assays were conducted on isolated capillaries using BODIPY-prazosin, a known fluorescent Bcrp transport substrate, Selectivity for Bcrp transport was determined using the competitive Bcrp inhibitor, KS-176.
Results: Changes to Bcrp expression were observed in a dose dependent manner following 3-day. 7-day and 14-day treatment paradigms. While no changes in Bcrp protein expression were observed at 3-hr, chronic low and medium dose administration showed significant increases in Bcrp expression at 7-days and 14-days. High dose acetaminophen administration triggered a significant increase in Bcrp protein expression at both 3-days and 7-days. Our western blot data were supported by increased immunofluorescent accumulation of BODIPY-prasozin within the lumen of isolated capillaries.
Conclusions: Our novel data show that APAP can alter expression and activity of Bcrp at the BBB, which may have profound implications for CNS drug disposition. As numerous other drugs are transport substrates for Bcrp, concomitant use of these medications with APAP could impair the effectiveness of currently marketed CNS therapies. Future studies are ongoing in our laboratory to assess the impact of therapeutic and high-dose APAP administration on pharmacological treatments for neurological disease states.

Bobby (he/him/his) is a Medical Pharmacology Ph.D. Candidate at the University of Arizona in Dr Patrick T. Ronaldson's lab. Born and raised in Tucson, Bobby finished his B.S. in chemistry and molecular/cellular biology before starting his master's degree in applied biosciences. Bobby then transferred into the Ph.D. program to focus on drug transport into the CNS. His current research aims to determine mechanisms which modulate pharmacotherapeutic drug delivery into the brain. While learning more about sociocultural health disparities in his graduate work, Bobby concurrently enrolled into the Master of Public Health program at the Mel and Enid Zuckerman College of Public Health where he hopes to better understand social epidemiological factors contributing to cardiovascular/cerebrovascular health.

Poster #38

Atomically Precise Group 6 Thiometallate Nanoclusters for Catalytic Transformations with Energy Consequence

Lauren Feden

Mixed group VI / base metal chalcogenide materials (where chalcogenide = S, Se) have been widely studied for their potential application in gas separation, water treatment, photoluminescent sensing, and catalysis. Specifically, MoS2 materials have shown high activity as electrocatalytic hydrogen evolution catalysts. Despite remarkable advancement in these platforms, atomic precision remains a challenge, and molecular clusters suffer from poor stability. Construction of atomically precise materials has the potential to engender enhanced robustness while maintaining structural tunability according to well-defined structure-activity relationships. We explore enhanced cluster stability with Mo/Cu chalcogenide cluster aggregation to form larger 'super' clusters with protection from bulky ligands. We discuss studies towards the synthesis of clusters that maintain crystallinity, stability, porosity, and catalytic activity. Overall, this work aims to extend mixed Mo/Cu materials to the atomically precise regime. Synthesis of cluster precursors and 'super' clusters will be discussed along with preliminary electrochemical studies.

Lauren grew up in Omaha, Nebraska. She completed her undergraduate degree at Hastings College earning a BA in Chemistry and Studio art. Lauren gained her love of inorganic chemistry completing an REU in the Barybin Group at the University of Kansas. She is a PhD candidate at the University of Minnesota in the Bailey group. Lauren currently works on developing synthetic strategies to stabilize metal sulfur clusters for catalysis.

Poster #39

Concentration-related optimization of the GSK3B inhibitor CHIR99021 in an in-vitro kinase assay coupled with ADP glo

Camilla Acosta

GSK3B inhibitors have been of great interest in the cancer field for their tumor suppressor effects. However, caution is needed in their application as they may be used at concentrations that differ from their specific inhibitory levels. GSK3B inhibitors regulate the Wnt/B-Catenin signaling pathway by preventing B-catenin degradation, allowing it to accumulate in the cytoplasm, translocate into the nucleus, and target gene transcription. CHIR99021, a highly selective, potent, and stable competitive inhibitor is the most widely used GSK3B inhibitor. Despite CHIR99021 being a highly selective and potent inhibitor, micromolar amounts have typically been used to inhibit GSK3-beta and activate the Wnt/B-Catenin signaling pathway in various systems. This tends to cause CHIR99021 to behave unlike its expected competitive inhibitor nature. Therefore, careful examination of CHIR99021 inhibitor concentrations is essential. To find the optimal inhibitory concentrations of CHIR99021, we tested GSK3B activity with CHIR99021 in the micromolar and nanomolar range using a GSK3B kinase assay coupled with an ADP-Glo reagent. The activity of GSK3B was characterized using increasing concentrations of ATP. GSK3B exhibited classic Michaelis-Menten kinetics in our ADP-Glo kinase assay without any inhibitor. Subsequently, GSK3B was incubated with increasing micromolar concentrations of CHIR99021 (0-32 uM), resulting in enzymatic activity that differed from Michaelis-Menten laws. Additionally, CHIR99021 did not behave as a competitive inhibitor in the Lineweaver Burk plot. When GSK3B was incubated with nanomolar concentrations (0-4 nM) of CHIR99021, it effectively followed Michaelis-Menten kinetics and CHIR99021 displayed competitive inhibitor behavior. These findings support our hypothesis that CHIR99021 does not behave as a competitive inhibitor when used in the micromolar range but does so in the nanomolar range. Future experiments will aim to examine CHIR99021 concentrations in the nanomolar range in cell lines.

Camilla Acosta is a young Mexican-American scientist studying Biological Sciences with a minor in Sociology at Chapman University. Camilla plans to pursue a career in research, examining the intersection between genetics and disease, due to their direct impacts on marginalized communities. She has had a wide range of research experience throughout her undergraduate career. She has been involved in projects relating to plant physiology, cell signaling pathways, cancer biology, and enzyme kinetics. In 2022, Camilla was accepted into and participated in a prestigious NSF REU at Sanford Research in Sioux Falls, South Dakota. At Sanford Research, Camilla studied under Dr. Kamesh Surendran, examining the interactions between the mTOR and Notch signaling pathways. Most recently, Camilla had the privilege of working under the mentorship of Dr. Jie J Zheng at the University of California, Los Angeles, through the Charles Drew School of Medicine and Science and UCLA's Undergraduate Cancer Research Training Program. Through this program, Camilla researched potential cancer treatments to limit activity of GSK3B. Beyond her academic pursuits, Camilla serves as Chapman University's Schmid College Senator for the Student Government Association, actively contributing to her university's student leadership and governance. Her dedication extends further to Chapman University's Diversity Affairs Committee, where she works to promote inclusivity and equity on-campus.

Poster #40

LGBTQ+ Science Students' Experiences, Perceptions, and Feelings of Discrimination in Their Science Departments

Madison Fitzgerald-Russell

The purpose of this exploratory qualitative study is to better understand the climate for LGBTQ+ science major undergraduates in their departments through a transformative queer theory lens and intersectionality. Prior research in campus and STEM department climates have demonstrated inclusion issues continue to persist for LGBTQ+ individuals in higher education. One of these issues is discrimination in the form of microaggressions. Microaggressions against LGBTQ+ individuals have been demonstrated to cause physical, mental, and academic harm to them. In the literature, there is limited information on how microaggressions impact students in particular STEM fields. LGBTQ+ science undergraduates from public colleges and universities in one Midwestern state were recruited via email to participate in semi-structured interviews to learn about their experiences with and perspectives on microaggressions. Participants completed a first interview to learn more about their experiences, followed up on online trailing related specifically to LGBTQ+ microaggressions, and concluded with a second interview. Emergent coding was utilized to capture the full perspectives participants provide by allowing for analysis to follow themes both related to the research questions and that the participants bring to the conversation. This presentation explores the experiences LGBTQ+ students in science described in their departments and in science spaces more generally. The study demonstrated that LGBTQ+ science students are aware of potential issues, but many struggle to articulate the issues and may better describe their experiences after being exposed to language related to discrimination and microaggressions.

Dr. Madison Fitzgerald-Russell (she/they) is a Postdoctoral Scholar at the University of Iowa, working with the HHMI-funded IE3 Learning Community Cluster 2 Research/Assessment team on supporting equitable and inclusive learning environments for introductory STEM students across a network of 14 institutions. They were previously a postdoc at Texas State University, where they worked with the STEM Communities Project and the Team Member Perceptions of Instructional Change Collaborations (TM-PICC) survey with faculty from Texas State University and Western Michigan University. She recently graduated with a PhD in Science Education: Physics from Western Michigan University, where her dissertation qualitatively explored the experiences and perceptions of queer-science major undergraduate students through a queer theory and intersectional lens. Their research goals include creating spaces for inclusion in and expanding equity of STEM education for marginalized folks in both K12 and higher education, focusing on queer and trans folks. She is a QTPiE Emerging Scholar, and has worked on organizing CUWiP@WMU 2021/2022, PERC 2022, and PRISMATIC 2023.

Poster #41

Usability Testing to De-Mystify the Digital Student Experience

Chelsey Tennis

The student experience is not only the events, spaces, and people students interact with: it is also the time they spend looking for questions and resources online. Understanding how students navigate digital webpages and resources is an important, yet overlooked, aspect of student success and satisfaction. To better support students in their self-advocacy journeys, we led design thinking exercises and conducted usability tests on the content, design, and navigation of our website. This highlighted a gap in what students were seeking and what information they could easily find. Further recommendations include visual designs and principles to implement to create a more seamless, cohesive, and delightful student experience.

Chelsey Tennis (they/them/theirs) is a LGBTQ+ educator and UX/UI Designer, interested in the intersection of experience design and the student experience. With a background in anthropology and higher education, Chelsey leverages design principles to create more impactful experiences for students. In their free time, Chelsey likes to listen to music, learn dance choreography, and doing DIY arts and crafts.

Poster #42

Slaying Limits, Accelerating Change

Alex Bien

The objective of this oSTEM poster is to elucidate the symbiosis of advanced scientific research and social inclusivity at the SLAC National Accelerator Laboratory. Predominantly, the poster outlines the instrumental role of SLAC's LGBTQ+ Employee Resource Group (ERG) in cultivating an inclusive work environment. This poster highlights the following ERG initiatives: community engagement, advocacy and policy, education and awareness, accelerator operations and safety division (AOSD), and key facilities.

The poster offers technical overviews of critical SLAC facilities—LCLS (LINAC Coherent Light Source), LCLS-II, FACET (Facility for Advanced Accelerator Experimental Tests), and SPEAR (Stanford Positron-Electron Asymmetric Rings). These facilities are essential for generating high-precision X-rays that support many other fields of scientific research, exploring advanced accelerator technologies, and previously, in groundbreaking particle physics research.

The poster is complemented by visual aids, including images from the SLAC pride celebration, a panoramic control room snapshot, a picture of one of the new accelerating cryomodules, and an overhead facility map.

In summary, the oSTEM poster aims to provide a nuanced yet accessible glimpse into SLAC's dual commitment to scientific rigor and social inclusivity.

I am a 2022 graduate with a B.S. in physics from the University of Maryland at College Park, and I currently operate the world's longest and most powerful linear particle accelerator administrated by Stanford University under the direction of the US Department of Energy. Here I interface directly with the machinery, controls, and safety systems for three linear accelerator facilities: FACET-II where electron-pair beams are shot thru hot plasma to study novel wakefield acceleration techniques, LCLS where coherent x-rays of very high energy (and inversely low wavelength) probe deep into matter for imaging at atomic scales, and the freshly commissioned LCLS-II where preparation is underway to deliver to users a much more powerful megahertz rep rate superconducting beam that can leverage the same XFEL mechanism to (instead of just taking snapshots) also resolve the dynamics of chemical reactions in situ. As an undergraduate, I conducted materials science research on ferritic steels at the National Institute of Standards and Technology (NIST) and also worked on graphene studies for a UMD laboratory associated with the National Security Agency (NSA).

Outside of science, I am a lifelong singer and a current tenor with the San Francisco Gay Men's Chorus—the world's first openly gay chorus. We engage in regular volunteer work at Bay Area high schools and perform in some of San Francisco's most iconic venues. Most recently, I had the honor of soloing as Glinda in ""What Is This Feeling?"" during a show themed around The Wizard of Oz, The Wiz, Wicked, and Elton John."

Poster #43

Occupational radiation dose trends in U.S. radiologic technologists assisting with fluoroscopically-guided interventional procedures, 1980-2020

Cato M. Milder (he/him)

Background: Recent studies have shown systematically higher and more variable occupational radiation doses for nuclear medicine (NM) technologists compared to general radiologic technologists employed in the 1980s-2010s. Considering the growing use of fluoroscopically-guided interventional procedures (FGIP) and rising patient volumes during this time period, descriptive studies of occupational doses to medical staff assisting with FGIP are also warranted.

Purpose: To summarize dose trends from 1980-2020 for U.S. radiologic technologists who regularly assisted with FGIP, overall and by work history characteristics.

Methods: We summarized 762,310 annual personal dose equivalents at a 10mm-reference depth ("doses") from 1980-2020 for 43,823 participants of the U.S. Radiologic Technologists (USRT) cohort who had annual dosimetry readings and responded to detailed work history questionnaires administered 2012-2014. This population included 19,651 technologists who reported regularly assisting with FGIP (≥1 time per month for ≥12 consecutive months) at any time during the study period. Using decade-specific work history questionnaire responses about a broad range of FGIP, we estimated doses by percent of time spent <3 feet of patients during FGIP, monthly FGIP frequency, and regular assistance with higher-dose FGIP. We used box plots and summary statistics (e.g., median, percentiles) to describe annual dose trends.

Results: Annual doses corresponding to regular assistance with FGIP (median=0.65 mSv, interquartile range [IQR]=0.60-1.40) were comparable to, but more variable than, those from general radiologic procedures (median=0.60 mSv, IQR=0.28-0.70). Close proximity to patients during assistance with FGIP was associated with higher and more variable doses (median=1.20 mSv; IQR=0.60-4.18) comparable to those from NM (median=1.20 mSv; IQR=0.65-3.01).

Conclusion: Annual doses to U.S. radiologic technologists assisting with FGIP were generally low but variable, and were correlated with exposure frequency, procedure type, and proximity to patients. These results highlight the need for vigilant dose monitoring, radiation safety training, and proper protective equipment for more highly-exposed medical staff.

Dr. Cato Milder is a postdoctoral fellow in the Radiation Epidemiology Branch of the Division of Cancer Epidemiology and Genetics (DCEG) at the National Cancer Institute. He has ten years of experience studying the long-term health effects of radiation exposure in populations including atomic bomb survivors, nuclear workers, medical staff, and astronauts. His current work focuses on characterizing radiation exposures and related long-term health effects to medical workers who use radiation to diagnose and treat patients. Throughout his professional career, Dr. Milder has also been active in diversity, equity, inclusion, and accessibility (DEIA) efforts. Dr. Milder is a transgender man who began transitioning while working at NASA and pursuing his PhD, and he hopes to expand visibility for LGBTQ+ scientists pursuing careers in non-LGBTQ+ health domains.

Poster #44

The Effect of Crosslinker Concentration on the Swelling of Polyethylene glycol (PEG)-based Hydrogels

Casey Dolan

Hydrogels are a widely utilized material due to their unique ability to absorb and release water. These materials have applications in diapers, contact lenses, drug delivery, and countless others. The influence of polyethylene glycol diacrylate (PEGDA) weight percentage on the swell ratios of hydrogels was investigated. Polyethylene glycol (PEG) and polyethylene glycol methyl ether methacrylate (PEGMEMA) hydrogels were created with varying amounts of the crosslinking agent, PEGDA. Molds made of polydimethylsiloxane (PDMS) were created to control the dimensions of the resulting gels and allow for efficient production. The swell ratio was calculated for each gel in order to quantify the changes in swell caused by the varying PEGDA weight percentages. To calculate the swell ratio, the gels were placed in deionized water for 24 hours and then weighed. The gels were then dried in a 40°C oven for 24 hours and weighed again. The ratio of the gels weight when fully swelled and fully dried was taken from these values, resulting in the swell ratio of each hydrogel sample. For both PEG and PEGMEMA gels, increasing the weight percentage of PEGDA decreased the resulting swell ratio. Introducing more PEGDA into the hydrogels caused more crosslinks to occur, which reduced the mesh size. Smaller mesh sizes limit the ability of the individual polymer chains to uncoil to the same lengths they achieve when less crosslinks are present, reducing the swell ratio. Controlling the PEGDA concentration within PEG and PEGMEMA gels increases the possibility of fine-tuning the swell ratio for use in a variety of applications.

Casey Dolan is a junior at Lehigh University studying Materials Science and Engineering. Her research interests center around the development of new biomaterials that will be affordable and easily accessible to all who would benefit from them. Being a queer woman in stem is a very important aspect of her identity! Casey loves baking, going to the gym, and listening to Taylor Swift.

Poster #45

Evaluation of a PCR amplification method based on Cyclospora cayetanensis mitochondrial genome

John Grocholl

Cyclospora cayetanensis is a protozoan parasite that causes foodborne and waterborne outbreaks of diarrheal illness named cyclosporiasis. A method for detection of Cyclospora cayetanensis based on a target on the mitochondrial genome was recently published and validated for regulatory testing by the US FDA. This method, which relies on conventional PCR followed by sequencing was designed on the basis of the parasite's mitochondrial genome and can detect approximately 5-10 oocysts of C. cayetanensis in produce and 6-12 oocysts of C. cayetanensis in agricultural water samples.

I am a contractor at the CFSAN Office of Applied Research and Safety Assessment, Division of Virulence Assessment at the FDA. My somewhat less traditional route to research and laboratory work has allowed me to gain firsthand experience in commercial plant greenhouses and facilities, and master essential microbiological techniques for the isolation and characterization of foodborne pathogens. I assist OARSA scientists in planning and conducting produce research projects with established criteria for use in the evaluation and assessment of human pathogen-produce interaction.

I conduct standard microbiological and molecular biology techniques such as bacterial culture, phenotypic arrays, nucleic acid isolation and quantification, PCR, and next-generation sequencing (NGS), e.g., support the scientists with the evaluation of data and information from different sources to determine the safety and effectiveness of produce as tested according to established protocols (e.g., Salmonella spp., Listeria monocytogenes, and Cyclospora cayetanensis
I am also a student at VA Tech finishing my master's in plant science and expecting to graduate December 2023. With this program, I am also working on projects researching the persistent of Listeria monocytogenes on lettuce.

Poster #46

A Robot-Assisted System Enabling Microsurgical Tasks for Opthalmic Surgery

Madison McIntosh

Over 4.2 million Americans experience vision loss, primarily due to age-related macular degeneration (AMD), diabetic retinopathy, and related ailments. Precise ophthalmic surgery is critical but is susceptible to human error, exacerbated by hand tremors in specialized medical professionals, leading to prolonged recovery, scar tissue formation, and complications. The subretinal space remains inaccessible without microsurgical technology, hindering patient care.

This research addresses these challenges by working towards developing a robot-assisted system for microsurgery with exceptional accuracy and precision. This system stabilizes a needle to a single degree of freedom for entry and exit at a fixed point in the eye, enabling the insertion of stem cells into the subretinal space to restore vision in AMD patients.

This microsurgical system prototype for ophthalmic surgery promises to advance microsurgical practices in collaboration with medical experts. This innovation offers hope for vision restoration, surpassing current gene-editing approaches and expanding access to necessary care. Efforts to access the subretinal space for stem cell insertion in visually impaired patients are ongoing. Our research aims to establish a fundamental device that enhances patient recovery, reduces complications, and fosters the evolution of new surgical techniques. These mechanical advancements may find application in membrane peeling procedures and other ophthalmic microsurgical tasks as our research progresses.

Madison McIntosh (she/they) is a junior biomedical engineering major attending Stevens Institute of Technology. She is the current co-president of her oSTEM chapter, and is the chairperson for the Diversity and Inclusion Commitee of the university. Madison is also the resident assistant of the Lore-El Center for Womens Leadership, as well as a teachers assistant for the introductory engineering programming course, and involved in greek life. Her primary interest is minimally invasive surgical technology, and she would love to pursue a career in clinical engineering after graduation. In their free time, Madison enjoys baking and binging reality TV shows.

Poster #47

CsgE Impacts the Aggregation of hIAPP

Chloe (Wug) Spears

Curli refers to a functional amyloid system that produces “sticky” filaments on bacteria that assist in pathogenesis. CsgE is a protein within this system that binds with other proteins to prevent the “ingredients” for Curli filaments from binding together too early in the formation process and aggregating within the cell. I have found that CsgE has the ability to influence the aggregation of other proteins. Specifically I examined the aggregation of human Islet Amyloid Polypeptide (hIAPP) is thought to play a role in insulin resistant diabetes. Proteins such as CsgE may prove helpful in identifying agents that are able to prevent the aggregation of disease causing proteins.

Chloe (Wug) Spears is an undergraduate researcher examining functional amyloid systems to better understand disease. They are currently attending CSUSM to earn a bachelors in biochemistry with minors in psychology and sustainability. When she isn't attending classes, purifying proteins, or working for their ACS student chapter, she enjoys exploring San Diego and spending time with loved ones.

Poster #48

Evaluation of Photovoltaic Module Performance Degradation through Chamber-based and In-Situ Outdoor Measurements

Stone Wilkes

This work was performed by Stone Wilkes, Kyle Boyer, Rokeya Jahan Mukti, and Kelly Simmons-Potter.

A pair of polycrystalline silicon photovoltaic modules were deployed at an outdoor test facility in Tucson, Arizona from April 19th of 2023 to August 25th of 2023 for a total duration of 128 days of sun exposure. The panels were grid-connected via a max power-point tracking inverter, and were fully instrumented to enable the collection of panel-rear temperature, string current, and string voltage. The test facility also has two on-site weather stations, which provided irradiance, wind-speed, and ambient temperature data at one-minute intervals. At six points during the deployment, the panels were taken for IV curve characterization and electroluminescence imaging. This study compares the results of performance and degradation analysis using each of the three datasets described, and compares these with the manufacturer datasheet.

Stone Wilkes (he/him) is a 4th year PhD student in the University of Arizona's Electrical and Computer Engineering Department. Stone's primary research focus is on the ionizing radiation effects on optical glasses crystals, and electro-optical devices. After completing his PhD, Stone is interested in working in the space industry developing technologies that can withstand the harsh radiation environments.

Poster #49

Surrogate Development for a Lyophilized Protein Drug Product

Sam Burger

Lyophilization is a process for drying drug products at low temperature and pressure conditions to improve shelf storage. It is a preferred manufacturing method for protein drug products that are prone to degradation in aqueous solutions or at elevated temperatures. During commercial process development, the scale up and tech-transfer of the lyophilization process requires a large amount of drug product to perform process characterization, determine the impact to product quality, and evaluate equipment capability. This is often hindered by limited material availability and process development economics considerations. The goal of this study was to develop a lyophilization surrogate for a protein drug product using cost-effective and readily available materials that can be used in a commercial manufacturing facility. By developing and characterizing surrogate formulations made of relatively less expensive and easily available materials, scale up and tech transfer studies can be done easily and economically. The surrogate formulations were developed using protein and polymeric substances to mimic drug product attributes that impact the lyophilization process, such as thermal and drying behavior and solution properties. Specifically, we evaluated the glass transition temperature, collapse temperature, density and the primary drying time, product temperature, and cake resistance during lyophilization. Overall, the study presents a systematic approach to develop surrogate formulations for lyophilization process development and commercialization of protein drug products.

Sam is a master's student at the University of Delaware where they are getting their degree in biopharmaceutical science after completing their bachelor's in chemical engineering. While pursuing their master's, Sam is also working at Merck as a co-op in the Sterile Drug Product Commercialization department. Their work focuses on the scale up and tech transfer of the lyophilization for biologic drug products. When not in the lab or in class, they are involved with LGTBTQ+ and/or science outreach.

Poster #50

Dynamics and Control of Oarfish-Inspired Powered Autonomous Underwater Vehicle

Zhangjingyi Jiang

Self-charging autonomous underwater vehicles (AUVs) offer many advantages, such as extended mission duration, operation in remote and hostile environments, and environmental monitoring and conservation. We proposed an oarfish-inspired AUV that uses anguiliform locomotion to have minimal impact on the surroundings. I focus on the simulation and control of said UV. The simulations will include a description of the hydrodynamic force model and the Finite Element Model (FEM). The design process of the controller will be explained and demonstrations of path-following obstacle avoidance will be shown.

Kelly (Zhangjingyi) is a second-year Ph.D. student in the Sibley School of Mechanical and Aerospace Engineering at Cornell University working with Professor Mark Campbell. Her research focuses on the dynamics and control of an underwater autonomous vehicle.

She previously graduated with a B.S. in Biomedical Engineering and a minor in Electronic Devices from the University of Southern California.

Poster #51

Nano for Neuro: Developing Hybrid Quantum Dot Nano-bio assemblies to Probe Neuroinflammatory Activation

Wesley Chiang

We have developed hybrid bio-inorganic nanoassemblies of quantum dots to study physicochemical drivers of neuroinflammation in various models of neurologic disease. By combining quantum dots with supramolecular self-assembly of polymers with tunable surface chemistry, I have constructed nanoparticle assemblies designed to mimic the structure and function of naturally occurring biological macromolecules, such as oligomeric amyloid-α42 and SARS-CoV-2 virus particles. These hybrid nano-bio assemblies benefit from the enhanced optoelectronic and photophysical properties of quantum dots that serve to benefit the achievable sensitivity and resolution in modern biophysical techniques. As such, these biomimetic quantum dots for oligomer amyloid-α42 (ABQDs) and SARS-CoV-2 (COVID-QDs) may be used as safer, fluorescent proxies for their naturally occurring counterparts; this reduces the biosafety risks typically associated with such pathological structures.

Thus, the scope of this poster will begin with a tour through the development and validation of the chemical processes to construct the hybrid quantum dot assemblies. This will be followed by the application of the ABQDs and COVID-QDs in both in vivo murine models and in vitro co-culture models of the neurovascular unit to elucidate how their natural counterparts modulate neuroinflammatory signaling cascades leading to neuropathophysiology relevant to Alzheimer's Disease and NeuroCOVID, respectively.

Wesley Chiang is a doctoral candidate in the Department of Biochemistry and Biophysics at the University of Rochester and is currently advised by Drs. Todd Krauss and Harris Gelbard. Wesley completed his B.S. in Biomedical Engineering as well as Materials Science and Engineering at the University of California, Irvine. He then came to the University of Rochester to pursue a M.S. in Optics, before finally transitioning into the Biophysics Ph.D. program where he was appointed a NIH T32 trainee in Cellular, Biochemical, and Molecular Sciences. His research interests include photocatalytic applications of doped nanocrystals as well as the construction of biomimetic quantum dots to probe protein-cell interactions that initiate neuroimmune responses relevant to Alzheimer's and NeuroCOVID. Outside of research, Wesley has spent his graduate career building a community and network for gender and sexual minorities at the University of Rochetser, as well as dabbled in some science policy.

Poster #52

RNA Structure Analysis Via Nuclear Magnetic Resonance

Chase Schubert

As observed in the recent Covid-19 global pandemic, infectious diseases can catastrophically affect our species. While vaccine research is unequivocally a crucial aspect of combating the effects of infectious diseases, the development of antivirals and antibiotics is highly important as well. Therapeutics that specifically work to mitigate already infected individuals are valuable for populations that lack either widespread vaccine accessibility or vaccine acceptance. Mapping the structure of pathogen RNA is vital so that drugs can be developed that specifically target its physical makeup. To achieve this goal, Nuclear Magnetic Resonance (NMR) spectroscopy can be utilized to interpret the physical structure of RNA.

Chase W. Schubert is currently a sophomore at Whitman College. He is majoring in biology with minors in chemistry and rhetoric.

Poster #53

Evaluating Water Quality Trade-Offs of Building Water Management Intervention Strategies

Vishnu Kotta

Water quality (WQ) degradation in premise plumbing is directly linked to negative repercussions for public health from pathogens (e.g., Legionella pneumophila) disinfection-byproducts (DBPs), and metal exposures. Some causes of WQ degradation include seasonal variations in the quality of incoming water, as well as stagnation in the system. The objective of this field study was to analyze the impacts of WQ intervention strategies, specifically, flushing the water lines, adjusting the water heater temperature setpoint, and a combination of the two interventions, on several microbial and chemical WQ parameters including cellular adenosine triphosphate (cATP), L. pneumophila, disinfection residual, disinfection by-products (DBPs), and heavy metal concentrations. Water flushing generally replenished disinfection residual and a negative trend was observed for both cATP and L. pneumophila when free chlorine concentration was elevated. Flushing also increased iron concentrations in the water, a metal necessary for L. pneumophila survival. Due to operational issues, the water heater setpoint intervention was not fully completed. Notably, an increase in copper concentration was detected during the water heater intervention and DBPs were elevated during some intervention events.

I'm a 4th Year Student at ASU studying Environmental Engineering. When not working on research, I enjoy reading (specifically literary fiction and poetry), hiking and time in nature, enjoying good food, listening to music, playing table tennis, and spending time with friends and family.

I am a child of Indian American immigrants and love to explore my culture and share it with others. I also identify as gay and am excited to connect with more people in the LGBTQIA+ community and learn from others and their lived experiences.

Poster #54

Characterizing Low-Frequency Vibratory Motion with Radio-Frequency Cavities

Harold Hart-Alesch

Mechanical oscillator systems with low energy losses have profound applications in both sensing applications and quantum physics as part of the up-and-coming field of "Levitodynamics." The use of a material's diamagnetic response to achieve levitation is often overlooked as a means of creating this sort of isolated system. We present results for magnetically levitated pyrolytic graphite slabs within a microwave cavity. The motion of the pyrolytic graphite slab perturbs the resonant microwave mode, which can be monitored to quantify the vibrational activity of the slab. This serves as a low-impact method of sensing the particle's position and movement and additionally allows for applications in cavity electro-mechanics. Acoustic measurements of a levitating 1mg slab of pyrolytic graphite in the 10 – 50 Hz frequency range utilizing a $\lambda/4$ coaxial microwave cavity with 10 GHz resonance are compared to calculations and video tracking data to test the effectiveness of this sensing method and losses in the oscillator.

Harold (Harry) is a fourth-year graduate student at the University of California Merced. While working on their Bachelor's degree in physics at the University of Wisconsin – La Crosse, they met their now husband, and in 2021, they moved across the country to California to pursue a doctorate in physics. In addition to the research they are currently doing in levitodynamics and optics, they are also interested in art, scientific visualization, and pedagogy. Alongside work in the lab, they are also currently an instructor of a course titled Inclusive Innovation, focused on highlighting the importance of examining and reaching out to communities in need during the research and design process in engineering.

Poster #55

A Computational Approach to Staging Disease Course in a Diverse Cohort of Patients with Progressive Multifocal Leukoencephalopathy

Milo Taylor

Progressive multifocal leukoencephalopathy (PML) is a debilitating brain infection caused by the JC virus. This polyomavirus regularly establishes persistent, asymptomatic infection in the general population but can result in devastating effects in patients who are immunocompromised. Advancement in development of treatments for PML has been hindered by its rarity, by the widely heterogeneous underlying conditions with varied patterns of immune compromise, and generally by a lack of reliable biomarkers for disease course. The standard of care is facilitation of immune reconstitution, but care must be taken to ensure that any intervention is titrated to prevent damage both by the PML itself but also from uncontrolled immune activation or IRIS (immune reconstitution inflammatory syndrome). As such, the patient's immune status is at the crux of PML clinical expression. Over the past decade, our lab has enrolled over 100 patients in the NIH PML natural history study, with standardized collection of clinical, radiological, virological and immunological outcomes. Although previous analyses have failed to elucidate clear patterns in immunological data, we hypothesize that trends may emerge when this longitudinal patient data is aligned by disease stage, and that some trends may be shared across underlying conditions. Here, we propose a computational analysis that harnesses CSF viral copy number, immune cell counts, and MRI metrics to temporally synchronize patient time courses. With this method, we hope to elucidate quantifiable phenomena that identify and predict PML progression, immune reconstitution, IRIS, and recovery. Not only could this analysis give researchers studying PML insight into the pathophysiology of this disease but may also provide tools to identify temporally specific interventions for patients based on disease stage. Such an approach could furthermore set a precedent for computational analysis of patient cohorts with other rare diseases, for which low numbers and heterogeneity are common challenges.

Milo Taylor, a recent Harvard College graduate, is a postbac IRTA in the lab of Dr. Irene Cortese in NINDS at the NIH. Here, they lend a computational perspective to the study of progressive multifocal leukoencephalopathy. They are a proud nonbinary lesbian hoping to pursue a career as a physician scientist. Outside of the lab, Milo is a co-chair of NIH Fellows and Friends, a LGBTQ+ affinity group for fellows, as well as an EMT at Rockville Volunteer Fire Department. They also enjoy spending time baking and crafting with their wife and cat.

Poster #56

Reproducing SN 1987A neutrinos and photons using self-consistent CCSN simulations of binary-merger progenitors

Erin Syerson

For decades, the neutrino observations of SN 1987a have been a challenge to model, partly due to the uncertainties in the relative timing of events between detectors. Successfully reproducing these observations is crucial to understanding the connections between the progenitor properties and their explosion dynamics. To do this, we run core-collapse supernova simulations using the 1D STIR framework (Couch et al. 2020) for multiple binary progenitors from Menon and Heger (2017). We then simulate predicted neutrino rates for the historical IMB and Kamiokande II detectors using the SNOwGLoBES software package. We also generate simulated biometric light curve models with the SN Explosion Code (SNEC; Morozova et al. 2015). The simulations are then compared to observation data collected in 1987. Our preliminary results show good agreement with the observed neutrino count rates and energies from both detectors, and provide a step towards understanding this important astronomical event.

Erin Syerson is a senior undergraduate student at Michigan State University (MSU) with a major in Astrophysics and a minor in Computational Math, Science, and Engineering. Currently, Erin works with the Physics and Astronomy department, doing research in computational astrophysics, with a focus in supernovae neutrinos. She also is a teaching assistant for quantum mechanics, introductory astronomy, and introductory coding in python. Because of these experiences, Erin has developed a passion for teaching and aspires to become a professor or educator in secondary education. In her free time, Erin enjoys exploring the local park, skateboarding, and attending football games and concerts.

Poster #57

Transient SST Interneuron Output in Fragile X Syndrome

Alister Orozco

Sensory information processing in the developing brain relies on the intricate connectivity between the thalamus and cortex through thalamocortical projections (TC). During early brain development, TC circuits undergo profound synaptic refinement crucial for the effective integration of sensory inputs. Within this maturation phase, somatostatin inhibitory neurons of the cortex (SSTcIN) play a pivotal role as the first recipients of TC inputs. However, unlike other synaptic connections in the brain, the thalamocortical projection to somatostatin inhibitory neurons (TC-SST) experiences a weakening, rather than strengthening, over postnatal weeks. This phenomenon is known as “”transient connectivity,”” and recent research suggests its importance in orchestrating cortical circuit refinement.

Fragile X syndrome (FXS) is a genetic disorder caused by a mutation in the FMR1 gene on the X chromosome, resulting in the absence of the gene product, FMRP. A prominent symptom of FXS is hypersensitivity, which is associated with the immaturity of the sensory cortex. We hypothesize that in FXS, the TC-SST connection is disrupted and persists beyond postnatal development. To investigate this hypothesis, we utilize FMR1-/- mice as a model to study the FXS phenotype. Preliminary results from slice electrophysiology experiments reveal that the TC-SST connection remains robust in FMR1-/- mice, while it weakens and undergoes pruning in wild-type (WT) animals. Our ongoing research aims to reveal the density of SSTcIN pre-synaptic outputs.

To explore the anatomical organization of inhibitory outputs from SSTcINs throughout the somatosensory cortex during postnatal development, we performed immunohistochemical staining against GAD65, the enzyme responsible for GABA synthesis and a marker of inhibitory presynaptic elements. This staining was conducted on FMR1-/- ::SST-CRE mice, which were injected with a CRE-dependent GFP reporter. Subsequently, samples were imaged using confocal microscopy and analyzed for colocalization of GFP(+) neurites and GAD65 with the IMARIS reconstruction software. Our preliminary results indicate a persistent TC-SST connection in FMR1-/- mice, this sustained connectivity may contribute to the sensory hypersensitivity seen in FXS patients, disrupting sensory information processing. Additionally, the abundance of SSTcIN output in specific cortex layers aligns with an immature sensory cortex phenotype, warranting further exploration of its function.

Alister Orozco (he/they) is a first-generation junior-year college student at Reed College in Portland, OR studying Biology and Sociology. He is passionate about pursuing transgender medical research with an MD/PhD after completing his B.A. At Cold Spring Harbor he researched the development of Fragile X Syndrome as a model of Autism Spectrum Disorder due to its high overlap with those who have Gender Dysphoria. All his research has been focused on underprivileged groups in America. This year he is the founder of Reed College’s Trans and Gender Non-Conforming Science Collective; a group focused on providing resources to LGBTQ+ STEM majors at his college.

Poster #58

Colorful Turán Theorems for the Vertex Disjoint Union of Rainbow Triangles

tahda queer

Given an edge-colored graph G, we denote the number of colors to be $c(G)$, and the number of edges to be $e(G)$. An edge-colored graph is rainbow if every two edges have different colors. A proper mK_3 is a vertex disjoint union of m rainbow triangles. Rainbow problems have been studied extensively in the context of anti-Ramsey theory, and more recently, in the context of colorful Turán problems. B. Li. et al. [European J. Combin. 36 (2014)] found that a graph must contain a rainbow triangle if $e(G) + c(G) \geq \binom{n}{2} + n$. L. Li. and X. Li. [Discrete Applied Mathematics 318 (2022)] conjectured a lower bound of $e(G) + c(G)$ such that G must contain proper mK_3. In this poster, we provide a construction that disproves the conjecture. We also introduce a result that guarantees the existence of m copies of rainbow cliques in general graphs, and a sharp result on the existence of proper mK_3 in complete graphs.

tahda queer is a trans Hakka exile and a first-generation undergraduate student, who is also a co-organizer of OURFA²M²(Online Undergraduate Resource Fair for the Advancement and Alliance of Marginalized Mathematicians). tahda studies math, logic and philosophy at City University of New York, and enjoys cooking spicy vegan food.

Poster #59

Robust Syndrome Extraction via BCH Encoding

Eren Guttentag

Robust error correction is essential to the development of quantum computers. However, syndrome extraction is itself vulnerable to errors, so it is advantageous to use a fault-tolerant procedure. The standard approach is to pick a stabilizer code and repeat syndrome measurements, but here we look instead at procedures that simultaneously encode both data qubits and syndrome bits.

An $[[n,k,d]]$ stabilizer code produces a binary syndrome vector of length $l:=n-k$. If any bits of the syndrome are flipped during measurement, the resulting erroneous syndrome vector may suggest an incorrect series of gates to restore the state. To prevent this, redundant measurements may be performed. It is possible to do this by simple repetition, measuring each of the stabilizers multiple times. However, we can more efficiently acquire redundant information by measuring additional elements of the stabilizer group; this is a quantum data-syndrome (QDS) code and it allows for simultaneous correction of data and measurement errors.

It is nontrivial to choose a set of stabilizer generators such that the resulting QDS code has a good total minimum distance. Instead we make use of syndrome measurement (SM) codes, where the syndrome is encoded using an $[n_{SM}, l, 2t_{SM}+1]$ classical code. This allows for a more efficient two-step decoding protocol. In the classical decoding step, the measured length-n_{SM} bit string is decoded, resulting in a length-l syndrome for the stabilizer code, which is then used to correct quantum errors in the second step. An advantage of a SM code is that the number of correctable syndrome bit-flip errors is easy to dictate and independent from the minimum distance of the stabilizer code.

We propose the use of primitive narrow-sense BCH codes to encode the syndrome bits. These codes are a class of cyclic binary codes of the form $[2^m-1, 2^m-R(m,t_{SM}) - 1, 2t_{SM}+1]$, where $R(m,t_{SM}) < mt_{SM}$ and m is the smallest integer such that $l \leq 2^m-mt_{SM}-1$. Note that this means $2^{m-2} < l < 2^m$, and so $\log(l)$ is $O(m)$. The properties of a BCH code are defined by the degree of the least common multiple of certain irreducible polynomials. Any BCH code can be shortened to create a $[2^m-1-a, 2^m-R(m,t_{SM})-1-a, 2t_{SM}+1]$ code. So a BCH code or shortened BCH code can be chosen to encode any number of syndrome bits, only requiring $R(m,t_{SM})$ extra measurements. As as result, our codes asymptotically require $O(mt_{SM})$ extra measurements, compared to $O(mt_{SM}^3)$ using Fujiwara's construction."

Eren Guttentag (he/him) is a transgender 3rd year PhD student in the Duke University Quantum Center under Ken Brown. His research interests focus on quantum error correcting codes, particularly fault-tolerant syndrome extraction and data-syndrome codes. He lives in North Carolina with his partner and cat, and enjoys classic sci-fi and indie video games.

Poster #60

3D Printed System for Simultaneous Stretch and Imaging of Engineered Microtissues

Maya Evohr

Cardiac hypertrophy is a condition causing arrythmias and heart failure. While genetics and chemical stress are partly responsible, mechanical stress also contributes to this condition. To investigate the interaction of mechanics with genetics, researchers require systems to apply mechanical stresses, like stretch, to genetically defined engineered heart tissues. This system must be small enough to easily fit under a microscope and must be easily replicated, allowing researchers to determine the consequences of mechanical load by studying how cells remodel their physiology and structure during tissue formation as well as comparing them to non-stretched tissues after tissue formation is complete. This knowledge aids in developing better models of cardiac hypertrophy, leading to better approaches to manage related genetic diseases including hypertrophic and arrhythmogenic cardiomyopathy.

In response, we created the stretch device and stretch chamber using Fusion360 computer aided design software and then prototyped them with polylactic acid using a fused deposition modeling technique. Hardware was added to enable the device to stretch 0.2mm per revolution of a screw. The stretch chambers consisted of four mounting holes around the edges and a recessed area containing four microdevices. The stretch chambers were fabricated using Hydrogel Assisted Stereolithographic Elastomer prototyping using agar to cast the chamber out of Sylgard 184 polydimethylsiloxane with a base-to-crosslinker ratio of 18:1. Experiments performed on NIH 3T3 fibroblasts were seeded into collagen gel to test the effects of stress on tissue and cell morphology.

We successfully created a stretch system composed of a PLA stretch device and PDMS stretch chamber. Fusion 360 modeling showed that forces exerted on the stretch chamber by the device were applied evenly and there was an equal stress distribution during the stretch process. The total system cost is under $30 and the system allows for live imaging of microtissues during the stretch. The system can be stretched to 77±20% strain before failure, well above the range of typical commercial strain devices. Our successful prototype for the stretch system has the potential to enhance research on the linkage between mechanical stretch and genotype-phenotype differences in genetic conditions causing cardiac hypertrophy and fibrosis.

Maya Evohr is an undergraduate student in the class of 2025 at Worcester Polytechnic Institute pursuing her BS/MS in biomedical engineering with a specialty in biomaterials and tissue engineering. Maya has conducted research at Cleveland State University and Washington University in St. Louis, and has presented her work at three national conferences. Outside of research, Maya is the Vice President of her university's oSTEM chapter and has served on their executive board since her first year at WPI. She is passionate about inclusivity in biomedical research and aims to serve minoritized populations with her work. She is currently an undergraduate researcher at WPI in the Pins Lab. You can find her on LinkedIn at https://www.linkedin.com/in/mayaevohr/ or contact her at mevohr@wpi.edu.

Poster #61

On the Efficacy of Machine Learning to Inform Thermal and Energy Aware Load Balancing for GPU Clusters

Rachel Finley

This study tackles the pressing issue of increased cooling demands in data centers, a situation intensified by the growing reliance on AI and GPU-heavy applications in corporate environments. GPUs, known to run hotter than CPUs, are the focus here, with the research aiming to use machine learning to predict GPU temperatures by building off of previous work done with thermal-aware CPU load-balancing algorithms. Due to an absence of existing datasets of data collected during GPU-intensive workloads, a novel dataset was created by monitoring a variety of computation-intensive applications across domains such as machine learning, image manipulation, signal processing, and finance. Data representing hardware states was collected from both GPU and CPU per second using a variety of diagnostic tools.

After extensive trial and error, an LSTM model was chosen for its excellent ability to forecast GPU temperatures, and it was subsequently incorporated into a load-balancing algorithm. The model was saved as a JSON binary file, making it easy to share with other researchers who will apply it in practical settings.

The future scope of this research includes benchmarking the thermal-aware load balancing algorithm against traditional methods. This comparison will likely be carried out using simulators like GPUCloudSim+ or by integrating the model into an actual load balancer. Such steps are crucial as they promise to fill the current void in real-world GPU workload data, potentially steering data centers towards more sustainable and cost-efficient operations.

Rachel Finley is a 26 year old-trans woman, and non-traditional STEM student finally pursuing a lifelong passion for the sciences. With a focus on Data Science, she is pursuing a career in research, hoping to be a valued contributor to interdisciplinary studies, or a valued member of an enterprise.