CALIFORNIA STATE UNIVERSITY
LONG BEACH
College of Natural Sciences
& Mathematics

Student Research Symposium

Book of Abstracts

Friday, September 20, 2024

Supported by: Jensen Student Access to Science and Math Center
& College of Natural Sciences and Mathematics

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California State University, Long Beach

Student Research Symposium

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Without their support throughout the year, this event would not be possible.

Symposium Booklet and Event

The Student Research Symposium is held in the University Student Union (USU) Friday, September 20, 2024. This event, held by CSULB, College of Natural Sciences and Mathematics is open to undergraduate and graduate participation. The research being presented at this event is from on-campus research and/or from summer research experiences performed at other universities.

The symposium provides an opportunity for students to write abstracts, produce posters, and present research findings thereby bringing scientific and non-scientific communities together to share in ideas and discoveries. Students, staff, faculty, administrators, and community members attend this event and enrich the experience of all participants. If this is your first time attending a symposium, feel free to walk around and ask the students questions about their research experience. We encourage any questions you may have about the research presented today. Thank you for attending our event.

The abstracts provided in this booklet are original works of students in our programs. Each abstract is included alphabetically by first author's first name.

Symposium Program

10:30-10:50am:	Check-in and research & resource fair (until 1pm)
10:50-11:00am:	Poster Session 1 Set Up
11:00-11:55am:	Poster Session 1 (Odd Abstracts)
11:55-12:05pm:	Poster Session 2 Set Up
12:05-1:00pm:	Poster Session 2 (Even Abstracts)

Coffee will be served in the Alamitos Bay Room at 10:30am.

Pizza will be served in the Alamitos Bay Room at 11:30am.

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1. **Hydrogen Evolution Reaction and Ni Deposition and Stripping on Au Surface**

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Electrodeposition of metal ions from aqueous solutions is essential not only to industrial processes but also due to their potential application in next-generation aqueous batteries. Here we study Ni electrodeposition on Au substrate as a model system to study metal ion deposition in aqueous media. Reducing Ni2+, Fe2+, Mn2+ and Zn2+ to their corresponding metallic states requires more reducing potentials than water reduction, so they compete with the hydrogen evolution reaction (HER) 2H+ +2 e- → H2 (g) in acidic environments. Here we use detailed electrochemical analysis to study the reduction and oxidation characteristics of various transition metals, including Ni. We use electrodeposition to prepare thin overlays of nickel at varying thicknesses onto an Au substrate. We use electrochemical surface stress analysis to study early stages of competing Ni deposition and water reduction reactions on Au substrate. Additionally, SEM is used to analyze the morphology of deposited Ni films. Our analysis shows that Ni deposition occurs through island growth mechanism which contributes to water reduction catalysis. We particularly show that surfaces with ca. 80 nm of Ni show the highest hydrogen evolution activity. These studies provide further insight into aqueous batteries based on metal electrodeposition and stripping.

Acknowledgements and Funding: Undergraduate Research Training Initiative for Student Enhancement (U-RISE) and Undergraduate Research Opportunity Program (UROP)

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2. **Identifying the upstream G-protein receptor mediating Calcium influx in RasV12 tumor cell dissemination**

Vincente Abatay and Jiae Lee

Department of Biological Sciences, California State University, Long Beach, Long Beach, CA 90840

Abstract: Dissemination is the initial process for tumor cells to metastasize throughout the body. To understand the mechanism of dissemination, we express the fly ortholog of the oncogene RasV12, a common mutation in human cancers in Drosophila midgut to describe cellular events of the tumor disseminating. During dissemination, RasV12-tumor cells

undergo morphological changes and form invasive protrusions that breach the extracellular matrix (ECM) and the visceral muscle (VM). Our previous results have suggested that E-cadherin/β-catenin dissociation which is essential for the dissemination is controlled by intracellular calcium signaling pathways where Ca^{2+} is released from the endoplasmic reticulum (ER) via the inositol triphosphate receptor (IP3R). To determine the upstream G-coupled protein receptors (GCPR) responsible for the Ca^{2+} signaling, we have performed candidate-based RNAi screening. Our study provides a unique opportunity to investigate the molecular pathway controlling tumor cell dissemination using an in vivo model with a native tissue context, giving insight into how calcium signaling affects tumor cell dissemination.

Acknowledgment: The research reported in this publication was supported by the National Science Foundation and the CSU Chancellor's Office under Award Number NSF HRD-1302873. The content is solely the authors' responsibility and does not necessarily represent the official views of the National Science Foundation.

3. Electrochemical Analysis of Mn Deposition in Aqueous Solutions

Aloni Harrell, Emily Marquez, and Hadi Tavassol, Ph. D.

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We report on electrochemical analysis and stress measurements of Mn deposition on Au substrates in aqueous media at different pHs and solution conditions. We will discuss how salt concentration and ionic species change Mn deposition on Au substrates. Mn electrodeposition, $Mn^{2+} + 2\ e^- \rightleftharpoons Mn\ (s)$, $E^0 = -1.185$ V vs. RHE, is not within the stability window of an aqueous electrolyte since it occurs at a much lower potential than hydrogen evolution reaction $E^0 = 0.00$ V. However, solution conditions such as pH and salt concentration can be used to extend the water stability window by increasing HER overpotential. Understanding the competing metal cation and hydrogen adsorbate formation mechanisms on substrates at different pHs is essential in the design of efficient Mn/Fe anodes of aqueous batteries. We will discuss our electrochemical stress analysis to study early stages of Mn deposition on Au substrates at different pHs and salt concentrations. Our early analysis of Mn deposition from MnSO4 and double-cation (Mn + Na) sulfate solutions show varying hydrogen evolution and bubble formation activities. We will show how pH of the solution and salt concentration can be used to limit interfacial water reactions during Mn deposition.

This project is supported by National Science Foundation Grant #HRD-230850, the Chancellor's Office of the California State University, US Department of Education, and OURS Connects.

4. Endogenously produced C1q modulates macrophage cytokine production

Shawn Austria, David Chiu, Deborah Fraser

Macrophages are a type of white blood cell that carries out our innate immune response. Resting M0 Macrophages can be polarized into different functional states: M1 (a pro-inflammatory macrophage), and M2 (resolving or anti-inflammatory macrophage). C1q is a protein complex that interacts with macrophages and is known to influence macrophage polarization. Previous studies show that exogenously adding C1q to macrophages promotes M2 macrophage polarization characterized by an increase in anti-inflammatory cytokine IL-10 and decrease in pro-inflammatory cytokines such as IL-1β. This study aims to test the hypothesis that endogenous, or naturally produced, C1q would have the same effect on macrophage cytokine expression. To test this, femurs were extracted from WT and C1q deficient mice, and monocytes were isolated and differentiated to macrophages. Bone marrow-derived macrophages were then polarized towards M1 or M2 macrophage phenotypes. Next the RNA was isolated, converted to cDNA and pro/anti-inflammatory cytokines: IL-1β and TNF-α (pro) and IL-10 (anti) were measured via qPCR. The results showed that C1q deficient mice had increased expression of IL-1β gene and reduced levels of IL-10. This suggests that endogenous C1q plays a role in reducing IL-1β pro-inflammatory cytokine production and enhancing IL-10 anti-inflammatory cytokine production. These results align with previous studies of exogenous C1q and support our hypothesis that endogenous C1q has a similar effect on macrophage cytokine expression. Understanding mechanisms of macrophage inflammatory responses are important because it may provide insight into a potential treatment target for inflammatory diseases.

5. Cardiovascular Dysfunction Induced Via Spinal Cord Damage

Grace Boulos[1,3], Zihan Yan[2,3], Mynor Orellana[2], Daniel Alarcon[3], Yun Fang[3], Armando Mendez[4], Angela Szeto[4], Pantelis Tsoulfas[3], Patrick Ganzer[2,3]

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Introduction:

Spinal cord injury (SCI) can result in serious physiological dysfunction throughout the body. Its effect on cardiovascular function, however, is not as well understood pre-clinically. In this study, we assessed the hypothesis that a SCI at spinal level C8 would result in both chronic physiological and histological cardiovascular deficits.

Materials and methods:

To investigate this, a midline contusion was performed at spinal level C8 in rats. We primarily investigated C8 SCI severity, cardiovascular dysfunction, and pathophysiological consequences on the heart tissue. At the end of the study, the spinal cord and heart were harvested following transcardial perfusion. The spinal cord tissue was stained with anti-myelin, and the heart was stained with anti-tyrosine hydroxylase (TH) antibodies, in addition to other markers of fibrosis, structure, and inflammation. A subset of the tissues were cleared, allowing for them to be imaged with 3D confocal microscopy. Once these images were captured, they were exported to a customized MATLAB app which allowed for the analysis of multiple factors, including spinal cord lesion extent (via labeling of white and grey matter within the left and right hemicords), as well as myocardial histopathology.

Results, conclusions, and discussions:

Our results demonstrate that C8 SCI results in cardiovascular dysfunction and specifically orthostatic hypotension. The C8 SCI extended multiple spinal segments above and below the lesion, quantified in MATLAB as percentages of tissue matter salvaged from the spinal cord. We will also present an analysis of the density of TH fibers in the heart using 3D imaging, addressing how sympathetic innervation may change post-SCI. Finally, we will also present data on myocardial immunohistochemical outcomes following trichrome, H& E, and staining of inflammatory markers in the heart.

This project is supported by the University of Miami Office of Graduate Studies and the National Institute of General Medical Sciences of the National Institutes of Health under Award Number T34GM149378. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

6. Investigating Pituitary Macrophages Functions in Comparison with Other Tissue-residents Macrophages via Phagocytic Activity and TLR Ligand Activators

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The Hypothalamic-Pituitary-Gonadal axis regulates the secretion of necessary reproductive hormones for healthy progenitive functions. However, inflammation can interfere with proper pituitary hormone secretion in reproductive disorders such as Polycystic Ovary Syndrome. While the correlation between inflammation and hormone imbalance has been established, the mechanisms of how the pituitary recognizes inflammation and consecutively leads to endocrinological downstream effects remain elusive. Preliminary lab data shows that pituitary macrophages, the primary immune cells in the pituitary, are unique to other tissue-specific macrophages based on their transcriptomic profiles. We aim to determine if these transcriptomic differences translate to functional differences by

comparing their phagocytic activities and toll-like receptor (TLR) activation profiles. Macrophages from the brain, pituitary, lungs, and liver were isolated from C57BL/6J mice. These tissue-resident macrophages were then incubated with fluorochrome-conjugated E. Coli to measure phagocytic activity. Results show that pituitary macrophages have higher phagocytic activity than other tissue-resident macrophages. Additionally, pituitary macrophages from male mice have higher phagocytic activity than females. To determine if pituitary macrophages have unique cytokine secretion and immune receptor expression profiles after activation, mouse tissue-resident macrophages were stimulated with TLR ligand activators. These activators polarize the macrophages into a pro-inflammatory state through two signaling pathways, MyD88 and TRIF. The activators included triacylated lipopeptide (Pam3CSK4) to target TLR2, double-stranded RNA (poly I: C) to target TLR3, and lipopolysaccharide (LPS) to target TLR4. TLR2 utilizes MyD88 only, TLR3 utilizes TRIF only, while TLR4 uses both MyD88 and TRIF. Studies are ongoing, but pilot experiments prove that the Luminex multiplex assay can measure 32 cytokines secreted from the activated tissue-resident macrophages. In addition, a flow cytometry panel using 15 markers was validated to identify innate immune cells and macrophage activation markers. Understanding the immune function of pituitary macrophages provides a more in-depth understanding of how inflammation contributes to the disruption of pituitary hormone secretion.

7. Math and ME: How Mathematics Research in the Classroom Can Change a Student's Relationship with Mathematics

David Chi, Dr. Jeffrey Pair

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In light of Course-Based Undergraduate Research Experiences (CURE), many STEM departments such as Biology or Chemistry have research experiences implemented within undergraduate courses. However, CUREs are rare in Mathematics departments. It is argued that Mathematics is a unique field that requires a large quantity of prerequisite knowledge, making mathematics research inaccessible to most undergraduate students. In a MATH 233 undergraduate course at CSULB called "Fundamental Concepts of Mathematics Course", a CURE was implemented in which students learned about Graph Theory research. Students kept journals throughout the semester requiring them to reflect on their experience as they examined and explored research from the mathematical field of Graph Theory. At the end of the semester, participating students gave permission for the researchers to analyze their journals for the purposes of this study. The journals involved the students' thoughts, feelings, reflections on personal identity and their relationship with mathematics. Extraction of the data from the students' deidentified journals were organized, examined, and analyzed using qualitative methods. The results revealed that students developed a more accurate depiction of who and what a mathematician really is. The students' experiences resulted in a clear picture of what is lacking in many mathematics courses—courses that can undermine

an interest in pursuing an advanced degree in mathematics or mathematics research. Students came into the course with an idea of where they wanted to go with their career and mathematics future—for some students, being exposed to mathematics research for the first time inspired them to imagine new possibilities for their future as mathematicians.

This work was funded in part by an Undergraduate Education grant from the W.M. Keck Foundation.

8. Investigating the Deletion Effects of *Trp53* in Gli1+ Cells in Molar Root Development

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P53 is a nuclear transcription factor with pro-apoptotic functions, located in the nucleus, that can promote cell cycle arrest in damaged cells. P53 facilitates DNA repair in damaged cells or induces apoptosis if necessary. Dysregulation of P53 allows cells to divide uncontrollably, leading to pathological conditions. Previous research indicates a direct regulatory interaction between *P53* and YAP, a downstream target of the Hippo pathway, in cancer cells. However, the crosstalk between P53 and the Hippo pathway during organogenesis is not well studied. In this study, we investigate the role of the *Trp53* gene (*P53* in humans) in regulating the fates of cranial neural crest cells (CNCCs) during development using the tooth root as a model. Our result shows that Trp53 is indispensable for root development. Deletion of Trp53 from Gli1+ cells results in shorter roots and differentiation defects of molar. Furthermore, our result suggests that loss of Trp53 leads to a downregulated Hippo pathway by reducing the expression of *Lats1/Lats2*, which further causes abnormal activation of active YAP. In addition, endocytosis as a downstream pathway of YAP is activated during root development and results in an elevation of cellular stress, causing further systematic homeostasis defects.

9. Learning to be Political: Social Work Students' Political Behaviors

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Scholars have found that recognizing racial injustice has motivated political action. If social work educators cannot forthrightly discuss institutionalized racism in the political process, does this effect social work student's ability to engage their clients as political actors? This study seeks to respond to this. Data comes from a self-administered survey of a sample of geographically and racially diverse MSW students. There was a total of 435 responses from 24 different states, with 55% of respondents enrolled in Californian social work programs. Respondents were asked whether they agree, or disagree, with a series of statements that

assess for teaching about racism and democracy. The structural equation model indicated good fit. Teaching students about institutional racism was a predictor of social work students' political behavior with clients (B = .136, p = .014) while political system beliefs were not (B = .136, p = .014). Having voted in the 2022 Midterm Elections was also positively associated with political behavior with clients (B = .195, p < .001). Lastly, students who identified as macro social workers reported greater willingness to engage their clients to engage in political behaviors (B = .206, p < .001). Preparing social work students for their ethical obligation to respect self-determination and engage in political action may require preparing them to recognize how institutionalized racism operates. In states with bans on teaching about racial justice, social work students may have limited conversations on such topics which may result their reluctance to encourage the political actions of their clients.

This survey research project was made possible through the support of a faculty grant from the College of Health Human Services, CSULB.

10. Viral Isolation of Diatom Infecting Virus in Southern California

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Diatoms are a diverse group of algae that play important ecological roles including producing 20% of global oxygen each year and contributing to nutrient cycling. In the oceans, diatoms are infected by a diverse suite of viruses which impact diatom evolution and population abundances. Such ecological and evolutionary dynamics can be understood through the establishment of model virus-host systems, but few diatom-infecting viruses have been isolated. This research aims to isolate diatom-infecting viruses to understand their impact on the physiology and ecology of different diatom genera. Seawater samples from Los Alamitos Bay, Long Beach were collected once per week from June to late August to attempt to capture diatom-infectiing viruses when diatoms bloom during the summer in the Southern California Current Ecosystem. Nine different diatom strains representing 5 distinct diatom genera were challenged with 0.2mm filtered seawater and monitored for cell death relative to control cultures. Culture color, which can be a proxy for cell death, was analyzed by a custom-fabricated device, digital photographs, and transformation of RGB values to sample luminosity. Samples with less luminosity relative to controls were considered lysed. Putatively dead cultures were then examined microscopically for the presence of intact diatom frustules and the absence of cellular material indicating lysis. In the initial round, 480 virus-diatom challenges were performed, and 30 of the challenges showed signs of infection. Six out of nine host strains were permissive to the putative infectious agents, with Chaetoceros sp. strain CSULB23.63 accounting for 30% of the total infections. July was observed to have the most infectious crosses with 13 lysates out of the 30 total that showed signs of infection. The lysed material was reintroduced to exponentially growing cultures of the same strain and then monitored to see if a reinfection cycle occurred

again. In the second reinfection round, out of 30 lysates, 5 showed signs of reinfection. The diatom strains observed to be the most permissive in the first round, Chaetoceros sp. strain CSULB23.63 and Thalassiosira sp. strain CSULB24.25, were they only strains that showed signs of reinfection. The samples that showed repeated infectious properties will be subjected to dilution to extinction to purify a single infectious agent. With further development of the technology used to monitor the cultures, we will have a better insight on the impact viruses have on marine ecosystems.

11. Sequences to Seas: Dynamic Evaluation of Marine Phage Metagenomes

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Marine picocyanobacteria are Earth's most abundant photosynthetic organisms, accounting for 20% of global oxygen production, making them critical to global ecosystems and biogeochemical cycles. Cyanobacteria are infected by viruses, called cyanophages, that impact cyanobacterial population abundances and diversity.

However, quantifying the global scale impact of cyanophages on cyanobacterial populations is poorly resolved because of a lack of suitable approaches to measure infection and the breadth of infection measurements made in the global oceans. An abundance of publicly available sequencing data collected across the oceans over the last 20 years could allow for the broad-scale assessment of cyanophage infection. Here, we seek to establish correlative relationships between newly developed quantitative methods to measure infection and metagenomic data. To evaluate the potential of metagenome-enabled quantification of infection, we curated a database of cyanophage genomes from public repositories including NCBI's GenBank and RefSeq and additional novel cyanophage genome assemblies from environmental metagenomes. We then mapped metagenomic sequences from station ALOHA in the North Pacific Subtropical Gyre across 44 time points, taken at four-hour intervals over approximately one week.

We observed low levels of alignment between sample reads and the current reference database. This alignment frequency supports quantitative measurements that were taken in parallel suggesting low levels of infection in the water at this time. This low alignment rate may alternatively indicate either insufficient viral representation in the current database or the presence of uncharacterized viruses within the sequenced samples. We are currently expanding the database to more broadly characterize the pangenome of cyanophages in the global oceans to test the effect on read mapping levels. The development of this bioinformatic pipeline will facilitate expanded studies aimed at evaluating the role of virus-infected microorganisms in global biogeochemical cycling, and incorporate decades of

archived sequencing data to elucidate broader trends in cyanophage infection levels and their potential impact on the carbon cycle and global biogeochemical processes.

This research was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Numbers; UL1GM118979; TL4GM118980; RL5GM118978.

12. Quantification of Diatom-infecting ssDNA Virus Populations Using the Polony Method

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Of oceanic primary producers, diatoms, unicellular microbial eukaryotes, account for 40% of marine carbon production. Diatoms' rapid growth and their ability to reach high cell densities make diatom populations susceptible to viral outbreaks, particularly during blooms, which can affect the fate of the carbon diatoms fix and, consequently, the larger ecosystem. Thus, quantifying the abundances and impact of viruses on diatoms is essential to understanding the functioning of marine ecosystems. However, a major roadblock to understanding the impacts of viruses on diatom communities is the lack of tools to accurately quantify virus abundances in the environment, particularly viruses with single stranded or RNA genomes. This impaired quantitative ecological understanding of diatom-virus dynamics is due to reliance on methods such as culture-based titers, qPCR, and metagenomics that cause the major diatom-virus families to be missed or severely underestimated. The polony method is a culture-independent, genome-enabled molecular method that uses degenerate primers and probes to enable population-level quantification of viruses from diverse virus families simultaneously. Here we extend the application of the polony method to quantify the abundances of the *Bacilladnaviridae* (BDVs), a major group of diatom-infecting viruses with partially single- and partially double-stranded DNA genomes. The diversity and phylogeny of BDVs within the larger Circular Rep-Encoding Single-Stranded (CRESS) virus phylum was assessed using two marker genes, the viral replication (vRep) and capsid protein (CP). Marker gene phylogenies were inferred from 5855 vRep and 8156 CP sequences. The BDVs clustered together and formed a monophyletic clade composed of the same taxa in each phylogenetic tree. Using these clade designations, each gene was evaluated for loci with maximally conserved positions which would be suitable for degenerate primer and probe design. In the vRep gene, five potential locations were identified, whereas three positions were identified in the CP gene. Primers and probes were then developed and tested in silico for their ability to match the 62 vRep and 42 CP sequences of BDVs, respectively. The vRep primers and probes had degeneracies of less than 5000 and could detect greater than 92% of known BDVs with no mismatches between the primer and target sequences. The CP primers had degeneracies of less than 5.3 x 106 and could detect only 78% with no mismatches. Thus, the vRep gene is being developed as

the primary target for the polony method for the BDVs. If the vRep primers prove capable of detecting BDVs in the environment, then BDV data can be used to answer future questions about the role BDVs have in regulating diatom abundances and carbon cycling.

This project is sponsored by COAST Undergraduate Research Award and CSULB Summer Student Undergraduate Research Assistantship RS596-00057-601303.

13. Designing Primers for the Nucleocytoplasmic Large DNA Viruses

Robert Garcia and Michael Carlson

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The Nucleocytoplasmic Large DNA viruses (NCLDVs) are a diverse family of viruses that are believed to play an important role in regulating phytoplankton populations in the oceans. Diatoms are unicellular, photosynthetic algae that modulate global carbon cycling and marine food webs and are thought to be infected by NCLDVs. However, no direct evidence of NCLDV infection has yet been observed although indirect genomic evidence suggests the presence of diatom-infecting NCLDV taxa. This study aims to quantify NCLDV populations in the world's oceans to assess whether their abundances track those of diatoms, which would indicate their ability to infect these phytoplankton. Here, we assessed the diversity of NCLDVs in order to develop degenerate primers that target the major capsid protein (MCP), which is a gene that is conserved across all NCLDVs. NCLDV sequences from NCBI's Viral RefSeq and environmental metagenomes collected in the North Pacific Ocean were identified and compiled using BLAST and Hidden Markov Model (HMMer) search algorithms. From 3,964 total sequences, an NCLDV phylogeny was inferred to identify sequences that clustered with suspected diatom-associated NCLDVs. A putative diatom-infecting NCLDV cluster, which fell within the Klosneuvirus clade in the NCLDV supercluster 6 (SC6), was identified and targeted for primer design. We characterized conserved regions within the MCP sequence to design primers that are suitable for the polony method, a solid-phase, single-virus PCR assay, and are testing the ability of these primers to detect SC6 NCLDV sequences *in silico*. These primers will aid in the detection and study of NCLDVs and how their abundances change in the waters off California's coast, contributing to our understanding of viral interactions between diatoms and the NCLDVs.

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14. A Genomic Exploration Into dsRNA Viruses in the Southern California Coast: A Polony Approach

Fabiana Paredes & Dr. Michael Carlson

Marine environments are home to vast numbers of viruses, with a single spoonful of seawater containing up to ten million viral particles—comparable to one-seventh of the global human population. Among their hosts are diatoms, single-celled algae responsible for up to 20% of global oxygen production and critical to marine primary productivity and carbon sequestration. However, there remains a gap in the ability to effectively identify and quantify viruses that infect specific host taxa, particularly diatoms. To investigate the prevalence of diatom-infecting viruses, we adapted the polymerase colony (Polony) method, a single-virus molecular assay that uses highly degenerate primers and probes, to quantify double-stranded RNA (dsRNA) viruses in the environment. We used the RNA-dependent RNA polymerase (RdRp) gene, a hallmark gene for dsRNA viruses, to develop RdRp-specific degenerate primers. To first assess dsRNA virus diversity, a Hidden Markov Model (HMM) approach optimized for the Reoviridae family (HMMreo45), a diverse phylum of dsRNA viruses prevalent in aquatic ecosystems, was used to scan the RefSeq viral database and environmental virus sequences from the Tara Oceans database for RdRp gene signatures. A phylogenetic tree of the dsRNA phylum Duplornaviracota was inferred from 5430 Duplornaviracota RdRp sequences. Eighty-two sequences clustered in a distinct, bootstrap-supported clade containing the only reported dsRNA viruses associated with diatoms (5 sequences) and unidentified environmental sequences within the Ghabrivirales order. This suggested the existence of a previously unknown lineage of diatom-infecting Reoviruses, which we called the Diatom dsRNA Virus clade (DdsRNAV). RdRp gene sequence variability within the DdsRNAV was analyzed and two potential primer sites were identified based on sequence conservation, potential amplicon size, and standard Polymerase Chain Reaction (PCR) parameters. *In silico* testing of primers against reference sequences indicated that a degeneracy of 1,536 could detect 86% of putative DdsRNAV sequences. These primers will be used for the development of the Polony method for the DdsRNAV in the lab and testing in the field. Further refinement of primer selection and possible expansion of the sequence dataset to include higher taxonomic ranks are ongoing. This study aims to enhance understanding of dsRNA virus specificity to diatom populations by amplifying, detecting, and quantifying viral infections along the Southern California coast.

Funding for this project comes from the COAST Grant Development Program and CSULB Summer Student Undergraduate Assistantship.

15. Isolation of Marine Diatom Infecting Viruses in Southern California

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Marine diatoms are photosynthetic unicellular microbes which are responsible for approximately 20% of Earth's primary production. This significant contribution to primary production warrants our interest in marine viruses as they can be a major control on diatom population abundances. Currently, only 15 diatom infecting viruses have been isolated, despite having been first discovered in 2002. Thus, this limited catalogue of viruses hinders our understanding of their genome, diversity, and abundance. The goal of this research is to isolate viruses that infect marine diatoms in order to understand their genomic and physiological characteristics and build upon this limited catalog. To isolate and purify viruses from the environment, nine different pure diatom cultures were isolated in October and November 2023 to gain insight into diatom-virus dynamics across different strains and seasons. These cultures were then challenged with the virus-containing fraction of seawater (0.2 µm filtrate) that was collected weekly from early June to late August from Ballast Point, Long Beach. Control cultures inoculated with sterile seawater and virus-challenged cultures were monitored by their changes in RBG luminosity, cell density in 48-well plates, and chlorophyll fluorescence. Virus-challenged samples were also monitored microscopically for evidence of cell lysing or cell death, specifically for cell well rupturing, chloroplast shrinking, or loss of visible fluorescence. Seven virus-challenge experiments were performed for the 9 different strains using three 48-well plates in replicates of twenty. Of these 420 virus-diatom challenges, 84 challenges showed declines relative to controls and were from the diatom genera *Chaetoceros*, *Cylindrotheca*, *Skeletonema* and *Thalassiosira*. The viral fraction from these putatively lysed cultures was reinoculated into healthy cultures and monitored for reproducible cell death. From the initial identification of 84 infectious agents, four virus-containing fractions were able to cause observable changes to cell density and cell morphology three times. Out of these four, two were from the genera *Chaetoceros* and two were from the genera *Skeletonema*. In the future, the virus-containing fractions will then be purified through dilution to extinction to ensure the isolation of a single virus from a potentially mixed virus community. This isolated virus will then be sequenced and monitored closely to determine its infection properties and dynamics. By doing so, we can learn more about the vast unknowns surrounding the properties and genetic makeup of marine diatom infecting viruses.

Acknowledgement: Learning Allied Employment Program

16. Characterization and Isolation of Viral Strains Infecting Diatoms in Ocean and Sediment Surrounding California State University, Long Beach

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Diatoms, unicellular, silicified autotrophic micro eukaryotes which are an integral component of the marine food web, providing the earth with approximately 20% of its primary production, and contributing significantly to carbon sequestration. Several different lineages of viruses infect and kill diatoms. As a result of viral infection, silica-ballasted diatoms are suspected to sink and accumulate at the bottom of the ocean. This potential virus-mediated movement of diatoms as part of the biological carbon pump makes marine sediments a likely place to encounter diatom viruses. Here, this research aims to isolate and characterize viruses that infect diatoms in the water column and sediments of California Current. Seawater and sediment samples were taken from Ballast Point in Long Beach and the wetlands in Newport Beach, California, respectively. The virus-containing fraction (<0.2µm) of these samples was inoculated to exponentially growing cultures of nine diatom strains including *Chaetoceros*, *Skeletonema*, *Asterionellopsis*, and *Thalassiosira* for a total of 216 and 96 virus-host crosses for seawater and sediment, respectively. Cell cultures were monitored for signs of culture death relative to controls by observing changes in culture cell density and color. There were 13 instances out of 316 total trials that demonstrated potential viral infection which were observed in *Asterionellopsis*, (CSULB 2315), *Chaetoceros* (CSULB 2396 and CSULB 2414), and *Skeletonema*, (CSULB 2340, CSULB 2354, and CSULB 2369). Interestingly, the rate at which seawater and sediment samples display potential infection was 4.63% and 3.13%, respectively. Samples of seawater generally showed signs of decline such as color loss or colony density loss in a shorter time, averaging approximately 6 days from initial plating until reaching a plateau in observable color and density loss, compared to sediment treatments where the average was 9 days. Collectively these data suggests that there may well be an abundance of virus in sediment as compared to seawater potentially due to the effect of the biological carbon pump on dead diatoms.

17. No Influence from Social Status on Sex-Specific Body Size in Rhesus Macaques

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In species that form social hierarchies, intraspecific competition is hypothesized to generate variability in phenotypes related to individual fitness such as body size. However, empirical evidence regarding associations between social status and body size remain mixed. Here, we tested status-related differences in size of rhesus macaques (*Macaca mulatta*) using

parallel laser photogrammetry methods. We used 53 adult monkeys of known sex and age and to test associations of social status in eye-rump and crown-rump length using multivariate linear regression models. Our results showed the expected sex differences (β= 4.28; t = 8.70; $p < 0.05$) and age-related changes in rump to crown length (β= -0.25; t = -4.52; $p < 0.05$). However, social rank was not associated to rump-crown length during adulthood (β= -0.40; t = -0.85; $p > 0.05$). Similarly, eye-rump length shared the expected sex differences (β= 4.59; t = 9.92; $p < 0.05$) and age-related changes in eye-rump length (β= -0.24; t = -4.58; $p < 0.05$). Social rank was also found to have no association to eye-rump length in adulthood (β= -0.47; t = -1.08; $p > 0.05$). Our results suggest that the impact of social status on sex specific body size is minimal when resources are plentiful and may contradict previous beliefs noting a significance of social status on sex-specific body size.

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18. Does the Stanol Composition of Animal Feces Impact the Use of Coprostanol in Tracing Human Presence on the Landscape?

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Fecal stanols are a class of organic compounds that form in the digestive tracks of animals and are introduced into the environment during defecation. Soil and lake sediments can be collected and analyzed for concentrations of these stanols. Coprostanol, in particular, has increasingly been measured as a proxy for human presence and density in specific regions because this stanol is present in very high concentrations in human feces. However, other animals produce coprostanol, which may complicate archaeological interpretations. Ideally, a “fingerprint” of different stanols in the sediment could be used to determine if the coprostanol is from humans or other animals. Using solvent extraction to isolate the stanols from the feces of zoo animals, we then analyzed the stanols on an Agilent Gas Chromatography Mass Spectrometer (GCMS). We present results from a study that analyzed eight fecal stanols in thirteen wild animals that originate from Africa, North America, and

eastern Asia. The animals were selected based on feeding strategy - herbivore, omnivore, and carnivore - and their likely proximity to ancient humans or sediment sources. Generally, herbivores produce the least amount of coprostanol; consistent with their diet. Both omnivores and carnivores produce, on average, nearly identical amounts of coprostanol, with chimpanzees having the overall highest amount of all the animals tested. The relative percentage of stanols helps identify the different feeding strategies. Herbivores have the most similar data to one another with low percentages of coprostanol and cholesterol and high percentages of 24-ethyl-coprostanol, a stanol derived from plants. Omnivores have more scatter in the data. They tend to have significant percentages of coprostanol and 24-ethyl-coprostanol, but lower percentages of cholesterol. Carnivores cluster tightly with very high percentages of cholesterol, small percentages of coprostanol, and almost no 24-ethyl-coprostanol. There are significant exceptions with some omnivores like bears plotting with carnivores, and certain wolves and African painted dogs plotting as omnivores. Our data suggest that coprostanol values be interpreted carefully in archaeological sites.

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19. Early Life Adversity and Body Size in Adult Rhesus Macaques

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Early life adversity predicts components of individual fitness through health and mortality risk. However, we lack knowledge about the underlying physiological mechanisms shaping these associations. In this study we investigated the relationship between individual and cumulative early life adversity and body size as an indicator of an individual's body condition in adult rhesus macaques (*Macaca mulatta*). For this, we implemented parallel laser photogrammetry as a non-invasive method to estimate the crown-to-rump length of 53 adult individuals. We found no evidence supporting a relationship between cumulative adversity and body size. However, our preliminary analysis suggests that certain individual adversities, rather than their accumulation, early in life influence body size during adulthood, after controlling for sex and age. In particular, population density effects at birth showed a statistical trend (β= -1.47; t = -1.84; p = 0.07), suggesting a density-related burden in which those individuals born into a high-density population will exhibit smaller body sizes in adulthood. Similarly, the interaction between sex and maternal inexperience at birth showed a statistical trend (β= -1.87; t = -1.82; p = 0.07) suggesting that first time mothers are more likely to raise smaller male offspring. Our analysis provides testable hypotheses for the underlaying mechanisms explaining the relationship between early life adversity and late life fitness outcomes.

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20. Ni-Catalyzed Reductive Cross Coupling Reaction to Prepare Dihydrobenzofuran Therapeutics

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Natural products, which are molecules isolated from living organisms, have shown significant potential as pharmaceutical agents for the treatment of various diseases. While some natural products can be extracted in large quantities from their natural sources, laboratory synthesis offers a means to improve their commercial availability and enable structural modifications to enhance their efficacy. Lignans, a diverse class of natural compounds, exhibit a range of biological activities, including anticancer, antimicrobial, and anti-inflammatory properties. Many lignans, such as maceneolignan A, feature dihydrobenzofuran cores with an aromatic ring positioned at the 2-position. Despite the existence of numerous synthetic strategies for dihydrobenzofuran-containing compounds, these typically involve early-stage introduction of the aromatic ring. Our research presents an alternative 10-step synthetic route to maceneolignan A, wherein the aromatic ring is installed at the final stage via a metal-catalyzed cross-coupling reaction. This approach facilitates late-stage diversification, offering a platform for the development of more potent inhibitors. Each step of the proposed synthesis has been validated using a simplified model system, and we have successfully completed the total synthesis of licarin B. All reactions were performed in the laboratory and the products characterized via proton nuclear magnetic resonance (NMR) spectroscopy. Our efforts have been particularly focused on optimizing the final step, which can achieve yields of up to 90% through a nickel-catalyzed reductive cross-coupling reaction. We are currently applying this synthetic methodology to the preparation of licarin B, with plans to extend it to the total synthesis of other biologically active natural products, including maceneolignan A, known for its anti-inflammatory activity, and acuminatin, an antioxidant. By altering the structure of the aromatic ring in the final step, we aim to produce additional bioactive compounds with potentially enhanced therapeutic properties.

This project is supported in part by the College of Natural Science and Mathematics and the CSULBIOTECH New Investigator Grant Program.

21. Organochlorine Contaminants in Sharks and Rays of Southern California

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Despite cessation of its production decades ago, the pesticide dichlorodiphenyltrichloroethane (DDT) has been of particular concern for Southern California due to past discharge of DDT-containing industrial waste into our coastal waters. In addition, other industrial-linked pollutants such as polychlorinated biphenyls (PCBs) are common in the region and are recognized as ongoing threats to wildlife and human health. DDT and PCBs can biomagnify through the food web, resulting in predators accumulating potentially high levels of contaminants. Elasmobranchs (sharks, skates and rays) span a wide ecological range so contaminant accumulation may be species-specific across varying degrees; however, they are typically excluded from consideration as vectors of pollutants despite their common use as cheaper protein sources especially by low-income communities. The current project quantified DDT (and associated metabolites), chlordane pesticides, and 54 congeners of PCBs in Pacific Angel Shark (*Squantina californica*) and Bat Ray (*Myliobatis californica*). We sampled muscle and liver tissue from animals collected in three regions (Los Angeles, Santa Barbara and northern Channel Islands) where we expect to have a range of contaminant exposure based on the distance from historic DDT dumpsites. Contaminants in tissue samples were analyzed via soxhlet solvent extraction and GC/MS. As expected, livers contained higher concentrations of pollutants compared to muscle, and we examined possible relationships between the two tissues. Animals from LA Harbor showed a tendency towards higher concentrations but with differences across species. Our results will provide valuable insights on the role of these fishes as biovectors of pollutants across different areas in Southern California.

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22. No abstract assigned

23. If the Shoe Fits: Strike Responses of the Round Stingray (*Urobatis halleri*) to Different Human Foot Sizes

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Injuries from stingray strikes are commonly experienced by beachgoers as stingray habitats often overlap with human recreation zones. Southern California is known for its stingray populations and associated human injuries, many of which are caused by Haller's round ray (*Urobatis halleri*), one of the most abundant species of stingrays in Southern California. The severity of injury resulting from a stingray strike can vary greatly and may be influenced by many factors. We previously studied the tail kinematics of *U. halleri* striking in response to stepping on them with a pseudo-cadaveric force application device (FAD), representing a human foot stepping on a stingray *in situ*. Our goal here was to assess how the strike response might change with scaled versions of our FAD, representing different sized human feet when stepping on rays. Our data using the adult-sized FAD indicated that rays escaped most of the time when stepped on a body region other than its midbody and were only likely to strike when pinned down at the center of their dorsal surface. With smaller and medium-sized FADs, there may be a lower chance of pinning down the ray, so we predicted to see an increase in the frequency of escape attempts. This would suggest that people with larger feet might be at risk for more severe injury than those with smaller feet.

This project is supported in part by the Department of Biological Sciences and CNSM at CSULB.

24. Feast-Fast Lifestyle: Physiological Effects of Daily Foraging Flexibility in Blue Whales (*Balaenoptera musculus*)

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Blue whales (*Balaenoptera musculus*), the largest animals on Earth, have highly variable daily feeding effort on the foraging grounds. Little is known about how this behavioral plasticity is reflected in their energetic costs .Here, we investigated how extreme foraging flexibility, a proxy for energy gain, affects respiration rate, a proxy for metabolic rate, by

analyzing long-term, high-resolution measurements of feeding and respiration rates in blue whales. From 2017 to 2023, 24 minimally invasive dart-attached tags were deployed on blue whales in the California Current ecosystem, yielding deployment durations from 1.5 to 18.3 days (Mean = 6.59, S.D. = 4.46). We used depth and kinematic data from tags and custom MATLAB tools to identify all feeding lunges and breaths performed during each deployment. We found significantly higher daytime feeding (11.5±11.0 lunges/hr) compared to nighttime feeding rates(4.3±9.4 lunges/hr). We also determined breathing rates during post-feeding recovery periods had a positive relationship with lunge rates during immediately preceding feeding periods. These findings will enhance our understanding of blue whale metabolic flexibility and resilience to anthropogenic change in the ocean, which, in turn, can inform conservation efforts of this endangered species.

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25. Assessing the Effects of Temperature on the Food-Induced Plasticity Response of the Pacific Sand Dollar, *Dendraster Excentricus*

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Adult Pacific sand dollars, *Dendraster excentricus*, are sustained through larval recruitment. These larvae possess robust phenotypic plasticity responses to cope with environmental changes. Previous research has only studied plasticity at 16°C or less. We hypothesized higher temperatures would amplify the typical plasticity response, measured by changes in postoral arm length to midline body length (PO:MBL) ratio. Sand dollars were spawned, and resultant larvae were reared at 16°C or 19°C. Larvae were fed 10,000 (high-fed) or 1,000 (low-fed) algal cells per mL. Repeated measures t-test revealed that larvae reared at 19°C exhibited significant feeding treatment differences in PO:MBL ratios earlier than larvae at 16°C. High-fed larvae at 19°C reached metamorphic competency earlier than high-fed larvae at 16°C. Due to the stimulatory effects of temperature on metabolic rate, larvae at 19°C were likely more food-limited than larvae at 16°C. This resulted in both an elevated plasticity response and slower development at 19°C. Underlying physiological efficiencies may also be temperature-dependent thereby contributing to differences in plasticity responses at the same algal concentrations. The amplified plasticity response at 19°C suggests that larval adaptive responses to food availability may persist as temperatures rise, highlighting their capacity to deal with near-term changes in temperature. However, our data also suggests that the compensatory value of increased arm length is diminished at higher temperatures due to it being outpaced by increasing metabolic demands.

26. Determining Whether SARS-CoV-2 Variants Bind and Infect CD4+ T Cells

Michael Anderson, Peter Ramirez, PhD

Infection with Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) leads to Coronavirus Disease (COVID-19). With over 775 million cases and 7 million deaths, the COVID-19 pandemic continues to represent a threat to human health and a burden to the global economy. SARS-CoV-2 infects cells of the upper and lower respiratory epithelia via the interaction between the viral Spike glycoprotein and the human host receptor, angiotensin-converting enzyme 2 (ACE2). SARS-CoV-2 Spike also binds to CD4, leading to infection and reduction of T helper lymphocytes. Because CD4+ T cells play a critical role in adaptive immunity, their infection by SARS-CoV-2 may be linked to a reduction of lymphocytes (lymphopenia) seen in some patients with severe COVID-19. Five SARS-CoV-2 variants of clinical significance have emerged: Alpha, Beta, Gamma, Delta, and Omicron. However, whether SARS-CoV-2 variants interact with CD4, and whether this leads to increased or decreased infection of CD4+ T cells, is unknown. We hypothesized that Omicron Spike would bind less efficiently to CD4 relative to Ancestral (Wu-1) Spike since infection with the Omicron variant leads to less severe disease. To evaluate this, we conducted bi-molecular fluorescence complementation (BiFC) assays and immunofluorescence (IF). We detected reduced fluorescence between Omicron Spike and CD4 compared to Wu-1 Spike and CD4, suggesting that SARS-CoV-2 infection of CD4+ T cells may differ across variants. Currently, we are determining whether SARS-CoV-2 Spike-pseudovirus particles (Wu-1, Delta, and Omicron) lead to differences in infection within a CD4+ T cell line. Determining whether SARS-CoV-2 VOC bind and infect CD4+ T cells represent opportunities for studying the evolution of SARS-CoV-2 with respect to transmission and virulence.

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27. Juvenile Bioenergetic Effects of Temperature and Food Availability in the Endangered Sunflower Sea Star, *Pycnopodia helianthoides*

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Pycnopodia helianthoides plays a significant role in maintaining the balance of kelp forest ecosystems by preying on sea urchins, which are voracious grazers capable of denuding kelp forests if left unchecked. However, in the 2010s, an epidemic of sea star wasting disease (SSWD) resulted in mass mortality of *P. helianthoides*, leading to regional extirpation in their southern range. This decline correlated with widespread increases in the prevalence of overgrazing by sea urchins and the degradation of kelp forests at regional scales. The

feasibility of reintroducing *P. helianthoides* via aquaculture is attracting growing research attention as a conservation strategy. This study focuses on bioenergetic impacts of temperature and food availability on the understudied juvenile stage of *P. helianthoides*, a particularly sensitive developmental period with the potential to create a population bottleneck. We hypothesized that juveniles at higher temperatures (16℃) and *ad libitum* feeding would exhibit higher ingestion rates, faster growth, increased respiration, and greater food conversion efficiency than juveniles at lower temperatures (9℃) and starvation.

Juvenile sea stars were reared at two temperatures (9℃ and 16℃) with starvation and ad libitum feeding. Ingestion rates were assessed by quantifying food consumption through counting uneaten urchins after feeding, and growth was measured by averaging the three longest body axes over time.

Our results show higher per capita consumption at 16℃ than juveniles at 9℃, though this trend was not statistically significant. Additionally, juveniles reared at 16℃ exhibited larger body sizes compared to those at 9℃. For a given temperature, fed juveniles were larger on average than starved juveniles. These observed differences in body sizes suggest that growth rates were likely higher at 16℃ with sufficient food, while starvation at 9℃ may have led to negligible growth. These findings generally align with metabolic theory, which predicts an increased metabolic demand at higher temperatures but they also highlight the complexity of bioenergetic responses in juvenile sea stars. Once respiration rates are analyzed, we will integrate these results to develop a dynamic energy budget (DEB) model for juvenile *P. helianthoides*. This model will help form predictions about how *P. helianthoides* might respond to changing environments and future climate scenarios which are crucial for future conservation efforts.

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28. Generation of Recombinant HIV-1 Nef Plasmids for Interaction and Immunofluorescence Studies

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HIV-1 Nef is a non-structural accessory protein necessary for the progression of Acquired Immunodeficiency Syndrome (AIDS). Nef participates in many pro-viral functions, including cell surface downregulation of CD4 and MHC-I, modulation of T cell activation, and enhancement of viral infectivity and replication. Expression of Nef leads to more infectious virus particles. How Nef performed this function remained unclear. We identified a host

protein, AnnexinA2 (AnxA2), that Nef interacts with and is required for Nef's enhancement of viral infectivity. This project aimed to create recombinant plasmids to determine whether the Nef/AnxA2 interaction is conserved across diverse Nef proteins. To do this, the nef coding regions from either Simian Immunodeficiency Virus (SIVmac239) or HIV-1 subtype C (97ZA012.1) were PCR amplified with a C-terminal epitope tag (HA). and inserted into a mammalian expression plasmid (pcDNA 3.1(+)). These plasmids will be used for co-immunoprecipitation (co-IP) and immunofluorescence studies to investigate protein-protein interactions involving Nef/AnxA2

PCR amplification was conducted using primers that introduced EcoRI and NotI restriction sites at each end of the gene. PCR products and pcDNA3.1(+) were digested with EcoRI and NotI enzymes, followed by ligation of nef into pcDNA3.1(+). The ligation product was then transformed into DH5α competent cells. The presence of ampicillin (Amp) on the agar plates serves as a selection marker to identify and isolate bacterial cells that have successfully taken up the recombinant plasmid.

To validate the recombinant plasmids, we performed colony PCR to confirm the presence of the inserts, followed by minipreps to isolate plasmid DNA. Sanger sequencing was used to verify the accuracy of the inserted sequences. Following successful sequence confirmation, midipreps were conducted to obtain larger quantities of plasmid DNA.

In conclusion, our project successfully constructed and validated recombinant plasmids expressing Nef subtypes SIVmac239 and 97ZA012.1 with an HA epitope tag. These plasmids are now available for future studies involving the expression and functional analysis of Nef proteins in mammalian cells. Further research can build on this foundation to explore protein interactions and the role of Nef in HIV pathogenesis.

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29. The Influence of Black-and-White Pet Models on Aposematic Color Generalization in Urban Coyotes

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Coyotes have been expanding their range since the beginning of the 19th century; currently, every major continental US city is home to populations of urban coyotes. With this urbanization comes the potential for human/wildlife conflict. One form this conflict takes is coyote predation on domestic pets, as urban coyotes readily predate cats and small dogs. Interestingly, preliminary research indicates domestic pets sporting black-and-white coat colorations may be better protected from coyote attack. These lucky pets may owe this

protective effect to yet another urbanized animal: the striped skunk. Striped skunks are aposematic – they advertise their noxious chemical defenses with conspicuous black-and-white pelage. The Stankowich lab has conducted research indicating that captive coyotes may have a predisposition to fear black-and-white coloration and can learn to generalize this coloration to an extent. Additionally, wild coyotes are more cautious of contrasting coloration and skunk-like body shapes. Furthermore, domestic dogs with skunk-like pelage have less severe interactions with coyotes. These studies indicate pets with more contrasting coloration may be better protected from coyotes than their monochromatic counterparts. To study this potentially protective coloration, I am placing highly realistic pet statues at several different sites in LA and Orange County. These statues consist of a cat, small dog, large dog, and striped skunk for a control. I have painted the pet statues in both monochromatic and black-and-white colorations, rotating them out on a weekly basis. Each station has a camera trap set up to record coyote behaviors with the models. Trials thus far indicate coyotes are interested in the models, with individuals interacting with them in a variety of ways. Although data is preliminary, I expect wild coyotes in my study areas to be generally warier of black-and-white pet models than of monochromatic pet models, evidenced by behaviors such as approach, proximity, physical contact, and time spent near models. If my research proves a link between skunk-like coloration and survivability of domestic pets, I may be able to develop protective tools such as black-and-white pet sweaters. Such tools can aid in alleviating human/wildlife conflict, especially in urban environments in LA County where urban coyotes have become a charged topic. Additionally, there is scant research on aposematic learning among mammalian carnivores, and my study will add to that body of knowledge.

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30. Determining the role of AnnexinA2 in SARS-CoV-2 infection

Angelica T. Cristobal, Pearl Lambarena, Maya Wyr, Peter W. Ramirez, Ph.D.

Continuous efforts have been made to understand the viral pathogenesis of Severe Acute Syndrome Coronavirus 2 (SARS-CoV-2), which is the causative agent of the coronavirus disease 2019, known as COVID-19. Recent studies have found possible interactions of the AnnexinA2 (AnxA2) host protein in SARS-CoV-2 attachment, entry, assembly, trafficking, and replication. Based on preliminary data, AnxA2 interacts with the viral Spike glycoprotein, a structural protein of SARS-CoV-2. We hypothesize that overexpression of AnxA2 will result in greater production and assembly of SARS-CoV-2 within mammalian cells. To test this hypothesis, we will generate SARS-CoV-2 virus-like particles (SC2-VLP) co-expressing four

SARS-CoV-2 structural proteins (Spike, Nucleocapsid, Envelope, and Membrane), a Luciferase packaging signal, and either plasmid DNA to act as a control or a plasmid expressing AnxA2. Following transfection of the plasmids into human embryonic kidney producer cells with the SV40 large T antigen (HEK293T), which do not express endogenous AnxA2, a series of assays will be used to detect the presence of viral processing and assembly. A nucleocapsid Enzyme Linked Immunosorbent Assay (ELISA) validated viral production as results show an increase in Nucleocapsid with increasing concentrations of AnxA2. After determining viral production, the amount of viral assembly will be validated using a western blot assay. Characterization of SC2-VLP production will warrant infection into target HEK 293T–angiotensin converting enzyme 2 (ACE2)/ transmembrane serine protease 2 (TMPRSS2) target cells, which we aim to test for infectivity using a luciferase reporter assay. Completion of these studies will enhance our understanding of SARS-CoV-2 assembly and/or entry, which can potentially lead to the development of novel antiviral agents.

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31. The role of riparian areas in enhancing mammalian biological pest control in agricultural landscapes

Authors: Mackenzie Clark and Dr. Ted Stankowich

The Santa Clara River Valley (SCRV), located in southern California, boasts high biological richness, and is considered a biodiversity hotspot of global significance. Agriculture is the predominant use of land in the mainstem section of the watershed and pesticides from agriculture operations have been found in watershed waters. In agriculture, anticoagulant rodenticides are a prevalent practice for reducing small mammal pest populations, despite their high risk of secondary poisoning of non-target wildlife, and their role as an environmental pollutant. Biological pest control may be a meaningful method for naturally suppressing pests in agricultural landscapes. The SCRV's role in the state's agriculture and pesticide consumption makes it a valuable place to begin for evaluating biological pest control in agriculture. Additionally, the role of riparian areas in implementing biological pest control should be explored, as these areas often serve as crucial habitats for predators that play a significant role in biological pest control strategies. I hypothesize that riparian areas with mammalian predators serve as a source of biological pest control for small mammals in adjacent agricultural landscapes. I secondly hypothesize that proximity to native riparian sites influences mammalian species richness and community assemblage in agricultural landscapes. To test my hypotheses, I will be using small mammal capture with Sherman traps, camera trapping, and an Adapted Hunt Drift Fence Technique (AHDriFT). My fieldwork is located along the Santa Clara River spanning eleven collaborating avocado and lemon

orchards, and four riparian areas. I expect to find evidence that riparian areas with natural predators contribute significantly to biological pest control in adjacent agricultural landscapes. My research will help inform growers of the SCRV how they can implement surrounding riparian areas to facilitate biological control in their orchards and reduce the use of harmful rodenticides.

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32. A SARS-CoV-2 Virus Like Particle (SC2-VLP)-Assay to Evaluate Heparan Sulfate-Like Compounds for use as broad-spectrum antivirals

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Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) is a zoonotic, enveloped, betacoronavirus that was the causative agent of the worldwide COVID-19 pandemic. SARS-CoV-2 contains a positive sense single stranded RNA (+ssRNA) genome and shares approximately 80% genetic similarity to SARS-CoV. SARS-CoV-2 primarily infects epithelial cells of the upper and lower respiratory tract. While effective SARS-CoV-2 antivirals exist (Paxlovid, Remdesivir), none target the early stages of infection to limit SARS-CoV-2 atransmission. Heparan Sulfate Proteoglycans (HSPGs) are widely expressed cell surface proteins that contain unbranched, negatively charged heparan sulfate (HS) polysaccharides. Diverse viruses including HIV-1 and SARS-CoV-2 use HS to attach to the cell surface, aiding viral entry into host cells. Sulfoglycodendrimers (SGDs) act as synthetic mimics of HSPGs that inhibit HIV-1 binding and entry. Whether SGDs also act to inhibit SARS-CoV-2 entry is unknown. Here, we adapted a SARS-CoV-2 Virus Like Particle (SC2-VLP) system to determine the effects of an SGD-like synthetic polysaccharide (dextran sulfate) on SARS-CoV-2 infectivity. SC2-VLPs are non-infectious and contain all the SARS-CoV-2 structural proteins (Spike, Envelope, Membrane, and Nucleocapsid) along with a luciferase transcript that is packaged within the virus particle. Thus, SC2-VLPs represent authentic aspects of SARS-CoV-2 entry, assembly, and release. We hypothesized that addition of dextran sulfate would reduce SC2-VLP infectivity. To test this, target cells expressing the SARS-CoV-2 receptors (ACE2/TMPRSS2) were or were not pre-incubated with varying concentrations of DS prior to infection with SC2-VLPs. We then measured luciferase activity as a readout for infectivity. Our results showed a significant decrease in infectivity with over 80% inhibition at sub-micromolar concentrations with a half-maximal inhibitory concentration (IC_{50}) around 34nM. These results indicate that our SC2-VLP assay serves as a reliable model to study

inhibition of SARS-CoV-2 attachment and entry and for our future directions of testing distinct SGDs as potential antiviral compounds.

This project is supported by the CSULB-CIRM Stem Cell Biotechnology Training Program and National Institute of Allergy and Infectious Disease award R16AI184450.

33. Expression of Human Chitotriosidase in *Escherichia coli* Using Autoinduction

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Candida albicans is a yeast-like fungus that is commonly found in commensal symbiosis with humans. However, it can also cause a life-threatening infection called systemic candidiasis. Treatment options for the disease are limited; with the emergence of drug-resistant strains, there is an urgent need for novel antifungal drugs. Previously, we have developed human recombinant antibodies against C. albicans that have been shown to be protective in a mouse model of systemic candidiasis. These antibodies promote phagocytosis of C. albicans cells, but they do not have a direct fungicidal effect. Our current goal is to identify antifungal proteins that can be fused with these anti-Candida antibodies as a hybrid protein where the antibody directs an antifungal protein to C. albicans cells for direct killing. A possible candidate is chitotriosidase, a human chitinase that breaks down chitin in the fungal cell wall and is therefore expected to be fungicidal. We have cloned the chitotriosidase gene and constructed an expression vector to make chitotriosidase in Escherichia coli. Previously, we used a chemical inducer to express the protein and obtained low yields. The purpose of this project was to adapt an autoinduction procedure to the expression of chitotriosidase where no chemical inducers are used. With this autoinduction procedure, we were able to produce large amounts of recombinant chitotriosidase that can be used for fungicidal assays.

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34. Design and Development of a Hand Prosthetic Device with Pressure Feedback for Manipulation Tasks

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For years engineers have tried to create advanced upper-limb prosthetics that are efficient and affordable. Although there are many advancements, a common reoccurring issue is not being able to give any sensory feedback to the patient which is important for motor learning. As a result, most users are unaware of how much pressure they are applying to the item they

grasp. The study's purpose is to create an upper-limb prosthetic with pressure feedback to the users to manipulate fragile objects. During this study, a prosthetic hand will be built from scratch and developed off SolidWorks. Meta-analysis was used in the first stages to compare past designs of transradial prosthetics and components used in general devices. The most common grip patterns have been observed and determined. Using mechanical actuation and force sensitive resistors for pressure feedback, we aim to create a working prosthetic with sensory characteristics. Quantitative and qualitative tests will be performed once the design is printed. A draft of the first design is currently in progress.

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35. From Sequence to Function, Creating A Framework to Predict Carbohydrate Processing Across Environments

Daniel Erdody

While the Carbohydrate-Active enZYme database (CAZY db) is an invaluable resource for studying Carbohydrate-Active enZymes (CAZymes), its limitations for sequence annotation have posed challenges for researchers, especially those attempting to use it for metagenomic analysis. Here, we annotate the CAZY db to include domain architecture, activity data, and amino acid sequences. We further analyze domain architectures within protein families to identify recombination events leading to multidomain proteins. By generating an enriched database with clear annotations alongside sequence analysis tools, this work establishes a method for non-bioinformaticians to annotate and predict CAZyme function directly, allowing broader research into carbohydrate processing across varying ecological and human-associated environments.

36. Investigating Muscle Fiber Formation on dECM-based Scaffolds

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Current regenerative laboratory studies explore the use of different materials for the repair of muscle tissue in individuals facing disease, injury, or volumetric muscle loss. However, many current approaches in creating muscle scaffolds and substitutes are not widely accessible, and some of the synthetic materials may not fully support muscle regeneration. One way to engineer a muscle scaffold is to incorporate a biomaterial like decellularized extracellular matrix (dECM), which promotes cell growth and differentiation. One way to utilize dECM is to incorporate it into a fibrin gel, created by the crosslinking of clotting elements fibrinogen and thrombin. The fibrin gel creates a scaffold for the cells with mechanics similar to soft tissues, and it is able to distribute cells evenly and support

proliferation. Another way is to incorporate dECM into collagen patches, which creates a scaffold that supports cell adhesion to the surface of the mold and, like the fibrin gel, supports proliferation. In this study, both types of scaffolds were created within grooved polydimethylsiloxane (PDMS) molds and seeded with C2C12 mouse myoblasts. After 14 days, the differentiation of the cells within the grooved PDMS molds exhibited better alignment and fiber formation. With dECM, we observed more cells and improved proliferation compared to growing the cells in media without any scaffold. By using natural biomaterials such as dECM as opposed to synthetic materials, possible complications regarding cell adhesion or rejection from the patient's immune system can be reduced. Current research is focused on investigating the use of dECM in the development of advanced muscle tissues as well as the optimization of the scaffold components to restore tissue structure and function.

This research is made possible by the CSULB Undergraduate Research Opportunity Program and Ayala Lab.

37. Demographic Structure of Tecate Cypress (*Hesperocyparis forbesii*) in the Northern Santa Ana Mountains: Population Viability in the Face of Fire

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Hesperocyparis forbesii (Tecate cypress) is a rare tree found only in Southern California and Northern Baja. Seed cone production begins at 5-10 years of age, with individuals reaching maximum seed production at 30-40 years. This makes the demographic study of *H. forbesii* essential for the conservation of the species, which is at high risk of extirpation due to the increasing frequency and intensity of wildfires in the Southwest. One *H. forbesii* population is found in the northern Santa Ana Mountains and partially under the jurisdiction of the Cleveland National Forest Forest Service. Surveys in 2009 found that this population was primarily composed of seedlings, making it vulnerable to being eradicated by large wildfires in the next 20 to 30 years. All four stands within the Cleveland National Forest were solely made up of adults, which are valuable due to their reproductive capabilities. This project compares the current demography of these CNF stands to their demography in 2009, evaluates their relationship to fire, and analyzes potential management strategies based on their risk of extirpation. It was expected for stands to have low demographic heterogeneity and be composed of few adult or mature trees, with a significant risk of extirpation due to increasing fire frequency. However, results indicate that the stands surveyed have more demographic variation, as well as greater variability in numbers and reproductive capacities, than anticipated. While this indicates these stands are less likely to undergo extirpation than anticipated, the unique characteristics and fire history of each stand yield significant challenges to management.

This project is supported in part by funding from the Bennet and Peggy Kayser Student Award. Preliminary results were presented to the Orange County California Native Plant Society.

38. Surveying Current Assessment Technologies and Future Innovations

Daisy Salmeron, Advisor: Drew Chapman, DTRA-ABQ, NM

Keywords: Surveying, Instrumentation, Technologies, Equipment, Assessment

The main focus was testing the accuracy and effectiveness of radio frequency (RF) devices. The goal of this project was to make a plan to acquire more intuitive devices that will expand over the next five to ten years. We approached this project by surveying current assessment technologies and analyzing their advantages and drawbacks. We participated in a search and rescue assessment where a Getac tablet and a spectrum analyzer were used to detect frequency signals of a device. Along with the assessment, we inventoried equipment to see their pros and cons. This is important since testing equipment capabilities should be adaptable to fast changing environments to ensure effectiveness of device functionality. Like in the case of search and rescue scenario, someone's life can be in danger if their locator device was not tested properly for functionality. Plans for the future instrumentation additions are more precise antennas that can reach better signals, a solar panel battery station so when individuals are sent to the middle of nowhere to test these devices, where there is no source of power. They can rely on another power source like solar power. Lastly a drone so they can scout more terrain at a faster rate. The next step is to purchase these new additions.

39. Engineering Hybrid Polyketide Synthases to Generate Therapeutic Natural Products

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Polyketides are a class of natural products that are produced in low concentrations by organisms such as soil bacteria and fungi. Of the known polyketides, many have medicinal properties such as being antimicrobial or neuroprotective, making them promising therapeutics. Despite these polyketides' pharmacological significance, there are many challenges associated with their large-scale production. While some therapeutic polyketides can be commercially biosynthesized using their native hosts, the vast majority cannot as their native organisms do not grow under laboratory conditions. Additionally, total organic synthesis of desired polyketides often results in poor yields due to these molecule's

complex structure and stereospecificity. However, we hypothesize that enzymatic synthesis, using engineered polyketide synthases (PKSs), is an effective method for producing desired, therapeutic polyketides. Type I PKSs are large enzyme complexes composed of multiple modules that catalyze the addition of specific ketide units onto a growing polyketide chain in a 'conveyor-belt' fashion. Due to their modular structure, hybrid PKSs can be engineered colinearly with desired polyketide products by mixing and matching modules from naturally occurring PKSs. In this study, we attempted to engineer a library of hybrid, tetramodular PKSs to catalyze the synthesis of a tetraketide lactone molecule, which will serve as a building block for the synthesis of a larger, therapeutic polyketide. The modules used in our hybrid PKS were identified using the ClusterCAD database (Tao et al., 2023), and the hybrid PKS-encoding plasmids were designed using the Design, Implementation, Validation and Automation (DIVA) program. To construct our hybrid PKS-encoding plasmids and insert them into the genome of our host organism, *C. glutamicum*, Gibson Assembly (Gibson et al., 2009) and Serine-Integrase Assisted Genome Engineering (Elmore et al., 2023) were employed. Results from Next-Generation Sequencing of our assembled plasmids indicate the successful synthesis of plasmid variants encoding the terminal segment of the hybrid, tetramodular PKS. Additionally, agarose gel electrophoresis of gene fragments used for construction of plasmid variants encoding the upstream PKS modules suggests that these gene fragments were successfully amplified and isolated from their natural PKS gene clusters. In the future, *in vivo* polyketide biosynthesis assays will be performed, and synthesized products will be analyzed using Liquid Chromatography-Mass Spectrometry. This study aims to further our understanding of PKS engineering strategy for polyketide synthesis and may assist future studies attempting to use hybrid PKSs for therapeutic natural product synthesis.

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40. If at First You Don't Succeed, Try, Try Again--Or Don't?: Statistical Modeling of the Replication Crisis in Psychology

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A replication crisis in psychological literature was diagnosed when Open Science Collaboration found that only 36% of a sample of studies successfully replicated. The field's search for a solution prompted the emergence of two popular approaches, arguing *for* or *against* direct replication. The current study aims to add perspective to this problem by examining if direct replication is a feasible solution to the replication crisis. To investigate

this problem, we constructed a statistical model to capture typical effect sizes in the published literature. Using this model, we simulated the replication of 30 studies and utilized Bayesian statistics to determine when enough evidence had been accumulated to resolve uncertainty about the original study's findings. We defined both moderate (BF = 3) and strong (BF = 10) thresholds for determining when a study has been resolved by the simulated replications. We analyzed our simulation data by averaging the number of replication attempts it took to meet the evidential thresholds. The results indicated that utilizing moderate and strong evidential thresholds would require an average of around 7 and 22 replications, respectively, before all studies were resolved. Therefore, assuming that replications require 1.5 years to complete, a sample of 30 studies would take, on average, 10.5 years using a moderate evidential threshold and 33 years using a strong evidential threshold. These findings suggest that direct replication may not be a solution to this crisis, but instead serve to hinder progress in the field of psychology.

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41. Investigating Post-Traumatic Epilepsy: Risk Factors, Biomarkers, and EEG Analysis Following Traumatic Brain Injury

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Traumatic Brain Injury (TBI) remains a pressing global health challenge, affecting millions annually, with many cases leading to long-term complications such as Post-Traumatic Epilepsy (PTE). PTE, characterized by seizures occurring after a TBI, is a condition that significantly impacts neurological outcomes. Recent advances in electroencephalography (EEG) analysis, particularly through Power Spectrum Density (PSD) studies, have enabled researchers to explore the relationship between brain activity patterns and the risk of late-onset seizures in TBI patients. In this study, EEG data from 22 moderate to severe TBI patients were analyzed, focusing on the predictive capacity of gamma band activity for PTE development. We utilized the Second Order Blind Identification (SOBI) protocol for Independent Component Analysis (ICA) to process EEG signals and employed PSD analysis across multiple frequency bands. Results demonstrated a significant increase in both low

and high gamma band power in patients who developed late seizures, suggesting that gamma activity could serve as a biomarker for predicting PTE. Our findings provide a basis for future research into the use of EEG biomarkers in clinical settings, potentially offering a non-invasive tool for the early detection and management of PTE in TBI patients. Further studies are necessary to validate these biomarkers across larger and more diverse populations. This work contributes to the broader understanding of post-traumatic neurological disorders and the potential for early intervention in at-risk individuals.

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42. Development of a Synthetic Strategy for the Total Synthesis of Dihydrobenzofuran Natural Products

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Natural products are molecules that have been isolated from living organisms, some of which have shown promising use as pharmaceutical agents for the treatment of disease. While some natural products can be readily extracted from natural sources on large scale, the ability to synthesize molecules in the laboratory can improve commercial availability and allow for modification to improve efficacy. Lignans represent a diverse class of natural products displaying various biological activity such as anticancer, antimicrobial, and anti-inflammatory properties. Many lignans, such as maceneolignan A, contain dihydrobenzofurans with an aromatic ring at the 2-position in the core of the structure. Although many methods have been developed to prepare dihydrobenzofuran-containing compounds in the laboratory, these methods rely on the installation of the aromatic ring early in the synthesis. We have proposed an alternative 8-step synthesis of maceneolignan A that installs the aromatic ring as the final step through a key metal-catalyzed cross-coupling reaction. Our approach is more amenable to late-stage diversification to discover more potent inhibitors. Each reaction has been carried out in the laboratory and the products were verified by proton NMR spectroscopy. Thus far, we have successfully synthesized licarin B, an antibacterial and one of the five target natural products, using a modified 10-step route. Our efforts have been focused on optimizing the yields of the oxidation and Suzuki cross-coupling steps, allowing the route to be reduced from 10 to 8 steps. Future work involves applying our synthetic route to demonstrate the first total synthesis of maceneolignan A, an anti-inflammatory agent, and prepare more complex natural products with biological activity. By altering the aromatic ring in the final synthetic step, we aim to synthesize related compounds, such as licarin A, maceneolignan B, and acuminatin.

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43. Assessing Claustrum Projection to the Anterior Cingulate Cortex in Pain Behavioral Disturbances

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Over 20% of US adults suffer from persistent pain conditions such as arthritis and neuropathic pain. The anterior cingulate cortex (ACC) is a cortical structure crucial to pain perception and negative affect, but afferent circuits modulating its activity during pain conditions are unknown. Recent studies have identified projections from the claustrum (CLA), a subcortical nucleus, to the ACC (CLA→ACC) and shown their critical role in acute nociception and reward seeking. However, the role of CLA→ACC in driving pain-induced alterations in reward seeking and negative affect remain elusive. Therefore, the present study aims to investigate: 1) the impact of inflammatory pain on reward-seeking, 2) the rewarding/aversive properties of the CLA→ACC, and 3) the temporal and anatomical details on CLA→ACC activity using fiber photometry and immunohistochemistry. To study reward seeking mice were habituated to an overnight sucrose pellet self-administration device for one week. Mice were then injected in the right hindpaw with Complete Freund's adjuvant (CFA) to induce inflammatory pain or sterile saline as control. An overnight test session was conducted two days after pain induction to assess changes in reward-seeking. We show that inflammatory pain alters reward-seeking behavior where animals experiencing pain consume rewards in bouts, shorter intervals to consume another pellet, compared to sham-pain control animals. Because CLA→ACC regulates reward seeking and nociception, we explored whether stimulating this pathway produces rewarding/aversive behaviors using the real time place preference test (RTPT) and an operant optogenetic self-stimulation procedure. After confirming the presence of dense projections from the CLA to the ACC, a separate cohort of mice were injected with a retrograde adeno-associated virus vector in the ACC, and a fiber implant was secured above the CLA. Two weeks after surgery, mice were exposed to RTPT. For RTPT mice were placed in a two-compartment box. Presence in one compartment was associated with optogenetic stimulation of CLA->ACC while presence in the other compartment had no consequences. Mice showed an aversion for the RTPT compartment paired with optogenetic stimulation, suggesting that CLA→ACC recruitment mediates negative affective states. Lastly, to assess the reinforcing properties of CLA→ACC, an optogenetic self-stimulation procedure was used for three days. Mice had access to two nose ports, one triggering CLA→ACC optogenetic stimulation and one that had no

consequences. Mice did not actively interact with nose ports, confirming the aversive properties of CLA→ACC activation. We are currently mapping the precise anatomical rostrocaudal pattern of activity in CLA→ACC upon application of noxious stimuli. Further dissecting the exact pain-induced alterations in CLA→ACC may lead to novel paths in improving the treatment of pain aversiveness.

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44. Spike-dependent Differences in Camelid Coronavirus Replication

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Middle Eastern respiratory syndrome (MERS)-CoV is a lethal coronavirus with pandemic potential. Middle Eastern camel populations serve as the main viral reservoir for MERS-CoV that spills over into humans. While African camel populations also harbor MERS-CoV strains, no reported transmission to humans has occurred. Interestingly, sequence differences in spike, the viral entry protein, of several African MERS-CoV strains have been identified. Previous studies indicate that temperature of upper and lower airways and interferon signaling response impact the extent of replication of coronaviruses. Therefore, we hypothesize that mutations in spike might result in differential sensitivity to temperature and interferon. We produced pseudotyped lentiviral vectors (PLVs), live HCoV-229E virus, and live MERS-CoV virus at either 33ºC and 37ºC, or in the presence of interferon. Samples from PLV and MERS-CoV live virus experiments were immunoblotted for spike, nucleocapsid, and p24. We found that control HCoV-229E entry and replication is attenuated at 37ºC compared to 33ºC. In contrast, MERS-CoV PLVs did not demonstrate temperature-related hindrance on entry. PLVs assembled in the presence of interferon experienced reduced entry to target cells. Interferon signaling responses in target cells decreased the entry of PLVs expressing African variant spikes. Interestingly, African variant spikes demonstrated diminished cleavage of full-length spike in both PLV and MERS-CoV live virus experiments. Understanding the phenotypes of MERS-CoV strains circulating in animal reservoirs is imperative to the management and prevention of future spillover events.

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45. Role of the Androgen Receptor in Sex and Age Differences in Home-cage Behaviors

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Automatic home-cage monitoring systems have been increasingly used for prolonged unbiased observations of spontaneous and more naturalistic behaviors in mice under a familiar environment with reduced human and novelty-related interferences. A new study used this approach to identify sex differences in motor activity and circadian-linked behavior in mice. Besides reproductive behavior, androgen receptor (AR) is also important for sex differences in many non-reproductive behaviors in mice, such as open field, social behavior, and object recognition in rodents. However, the role of AR in sex differences in home-cage behaviors hasn't been defined yet. In addition, the decline in androgens may be an important factor in behavioral aging in males. Thus, in the current study, we used testicular feminization mutant (Tfm) mice, lacking functional AR, to test the hypothesis that the masculinization of home-cage behaviors was mediated by androgen-induced AR activation, which was abolished as age advanced. To test this, we individually caged and video-recorded young and middle-aged, wild-type female, wild-type male, and Tfm male C57BL/6J mice (n = 9-11 per group) in a Noldus' PhenoTyper with a 12h:12h light:dark cycle (light on 0600 h) for 54 h (starting from 0800 h). Food chow, water, bedding, nestlets, an enrichment tube, and a running wheel were available in the cage. For each animal, the distance traveled, number of running-wheel revolutions, number of water-bottle licking, and number of feeder access during a selected 24-h period (from 0600 h on the second day to 0600 h on the third day) were measured by EthoVision XT. Regardless of genotype or age, all six groups of mice displayed higher activities of locomotion, wheel running, drinking, and feeding during the dark phase than the light phase. During the dark phase, young wild-type females displayed higher wheel revolutions than wild-type and Tfm males, which was reduced in middle-aged wild-types. In contrast, the distance Tfm males traveled was shorter than wild-type mice regardless of age. Besides locomotion, young wild-type mice licked the water bottles more often than Tfm mutants during the dark phase while the numbers of licks in middle-aged female and male wild-types decreased compared to young conspecifics. Opposite to drinking and wheel running, aging increased the travel distance and number of food access during the light phase. Together, our results demonstrate that in a home-cage setting, sex differences, phase of the light cycle, aging, and functional AR modulate locomotion, drinking, and feeding in mice.

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46. Sex Differences in Postprandial Inflammation

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Fat-enriched diets are a risk factor for prevalent diseases in the U.S., including cardiovascular disease, type 2 diabetes, and some types of cancer. Following a high-fat meal, the body enters a postprandial state with elevated blood levels of lipids and pro-inflammatory lipopolysaccharide (LPS), which is derived from resident gram-negative bacteria in the gut. Circulating LPS may contribute to chronic metabolic inflammation through activation of tissue macrophages throughout the body. In humans, postprandial inflammation is higher in men than in women, but the mechanisms are unclear. We used mouse models to investigate how biological sex influences the levels of postprandial LPS and macrophage response to LPS. Following a single fatty meal, male mice had greater elevations in circulating LPS levels, and male bone marrow-derived macrophages exhibited greater inflammatory gene expression when exposed to LPS. Investigation of the basis for this sex difference in the Four Core Genotypes and XY* mouse models revealed that the presence of a Y chromosome promotes both elevated postprandial LPS levels and macrophage inflammatory response. These studies indicate that compared to females, males are more vulnerable to inflammation associated with dietary fat, and that this is genetically determined by the Y chromosome. This may contribute to the greater morbidity of males to cardiometabolic diseases that are associated with metabolic inflammation. Future studies will seek to identify genes on the Y chromosome that promote postprandial inflammation.

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47. Age-dependent Alternative Splicing of *Mapt* in the Developing Mouse Cerebellum

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The MAPT gene encodes the tau protein responsible for the assembly of microtubules and axonal stability in neurons. Alternative splicing of *MAPT* mRNA is extensively regulated ; splicing of exons 2 and 3 give rise to tau isoforms with 0 (0N), 1 (1N), or 2 amino-terminal repeats (2N), and splicing of exon 10 give isoforms with 3 (3R) or 4 microtubule-binding repeats (4R) in the carboxy-terminal of tau. Differential expression of the MAPT isoforms is critical for neural development and function. Our early study demonstrated that in the

mouse cortex/hippocampus, 3R variant was detected only at postnatal days (PN) 0 and 7 while 4R appeared at PN7 and was exclusively expressed by PN14. Concomitant with the age-dependent inclusion of exon 10, mRNA levels of two *Mapt* exon 10 excluders, splicing factor, suppressor of white-apricot (*Sfswap*) and RNA-binding motif protein X-linked (*Rbmx*), decreased a week after birth. In the current study, we aim to determine if the developing mouse cerebellum shows similar age-dependent changes in *Mapt* splicing and expression of splicing regulators required for processing *Mapt* transcripts. To address this, we have extracted RNA from the cerebellum of male and female C57BL/6J mice at PN0, 7, 14, and 21. Using RT-PCR, we first found that the developing cerebellum expressed only 3R at PN0 while 3R and 4R (with exon 10) both were present at PN7 and PN14. By PN21, only 4R was detected in the cerebellum. The developmental transition of 3R to 4R seems to last longer in the cerebellum than the cortex/hippocampus. In addition, 0N transcript was dominantly present throughout the first three weeks after birth, and traceable 1N and 2N were not detected until PN14. Using RT-qPCR, we are measuring the mRNA levels of the *Mapt* exon 10 and its splicing regulators in the developing mouse cerebellum within the first three weeks after birth.

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48. Determining how HIV-1 Nef requires Annexin A2 to enhance HIV-1 infectivity

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Human Immunodeficiency Virus type-1 (HIV-1) relies on a series of accessory proteins (Vif, Vpu, Vpr, and Nef) that aid in viral pathogenesis. Nef (negative factor) is a peripheral membrane protein that is expressed early in the HIV-1 replication cycle. Expression of Nef enhances the infectivity of viral particles (virions). Clinically, Nef plays a key role in the progression of HIV-1 to AIDS. How Nef creates a more infectious virion and whether this relies on the interaction with specific host proteins is unclear. Using virion-associated proteomics, we identified candidate "dependency" factors, or proteins that Nef utilizes to enhance infectivity. One of these proteins was AnnexinA2 (AnxA2), a membrane associated protein that participates in several biological functions, including the organization of lipid rafts. These cholesterol-rich membrane microdomains often serve as platforms for viral entry, assembly, and release. AnxA2 has been exploited by several RNA and DNA viruses to aid in viral replication. Silencing of AnxA2 decreased HIV-1 virion infectivity. Conversely, overexpression of AnxA2 led to enhanced HIV-1 infectivity. Using Bi-Molecular Fluorescence

Complementation (BiFC), we also found that Nef physically interacts with AnxA2 within living cells. We hypothesize that AnxA2 mediates the localization of Nef to lipid rafts present on the plasma membrane, enhancing HIV assembly, budding and infectivity. To test this, we are currently validating the Nef/AnxA2 interaction via co-immunoprecipitation (Co-IP) studies and determining how AnxA2 may recruit Nef to sites of viral assembly using immunofluorescence (IF) and cell fractionation assays. Additionally, we are using CRISPR/Cas9 to generate an AnxA2 knockout within a human leukemia T cell line (CEM) to compare HIV infectivity with and without AnxA2 present within the host cell. The completion of this work will enhance our understanding of how HIV-1 utilizes its host cell's machinery to increase its infectivity and has the potential to inform the development of novel Nef inhibitors.

49. Synthesis and Characterization of Deep UV Masking Metal Oxides; Band Gap Tuning in Semiconductors

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Ultraviolet (UV) radiation is composed of both UV-A and UV-B rays that penetrate the skin and cause damage depending on their wavelength. UV-A rays have longer wavelengths that can penetrate deeper into the dermis level of the skin and damage the collagen and elastin fibers resulting in wrinkles and inflammation. UV-B rays have shorter wavelengths and higher intensity than UV-A, causing DNA damage that leads to sunburn, and skin cancers like melanoma and basal cell carcinoma. To protect skin from these harmful radiation, organic and mineral inorganic sunscreens exist. Organic compounds function through the excitation of conjugate chains and rings by absorption of photons, followed by an emission of energy through thermal dissipation. Similarly, inorganic material-based sunscreens contain metal oxides with non-metallic behavior *i.e.* ZnO or TiO_2 whose semiconductor properties allow for the UV radiation to get filtered. The size of the band gaps in the semiconductors determines the region of the spectrum that will be filtered. The photon is absorbed along with the excitation of the electrons from the valence bands to the conduction bands. Metal oxides are the superior environmentally friendly alternative, as various studies have shown that organic-based sunscreens contribute to coral bleaching and degradation. A drawback of current commercial sunscreens is that they do not effectively block both UV-A and UV-B radiation. In this project, solid-state synthesis methods were conducted to explore the possibility of tuning the band gap size in more complex metal oxides, which are composed of ZnO, TiO_2 or both. However, there is not a compound that blocks UV-A and UV-B at complete efficiency. The UV region covers the electromagnetic spectrum wavelength range of 100-400 nm. The damaging UV radiation wavelengths are UV-A (315-400 nm) and UV-B (280-315 nm). The band gap of UV-B ranges from 4.43-3.94 eV and UV-A from 3.10 -3.94 eV band gaps.

Utilizing a mortar and pestle the reagents were mixed to create a homogenous mixture, and then hydraulically pressed into pellets (0.5g). The pellets were heated in a Lindberg Blue M Furnace at high temperatures until phase purity was obtained. The phase formation and purity of the samples were confirmed by powder X-ray diffraction technique. The band gap sizes were determined employing diffuse reflectance spectroscopy. In this study, the bandgaps of UV-masking metal oxides were measured to design more advanced formulations. Further research into inorganic compounds; Zn_2TiO_4 and $Mg_2Ti_3O_8$ will continue in order to obtain a wider range of materials for blocking harmful UV radiation in skin care products.

50. Investigating the Mechanism of b-AP15-Induced Integrated Stress Response

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Cancer cells often utilize the Integrated Stress Response (ISR) to survive adverse conditions by halting general protein synthesis and increasing specific stress-response proteins, such as ATF4. This adaptation can either protect the cells or lead to cell death, depending on the severity of the stress. The small molecule b-AP15, a known deubiquitinase inhibitor, is a common anti-cancer agent thought to induce apoptosis by disrupting proteasome homeostasis. However, a recent study from our laboratory suggests that SC66, a compound analogous to b-AP15, activates the ISR, leading to cell death. This work investigates whether b-AP15 also activates the ISR in cervical (HeLa) and colorectal (DLD1) cancer cells, and examines the effects of co-treatment with the antioxidant N-acetylcysteine (NAC). Analyzing the cell lysates of control and b-AP15-treated cells via western blotting, we found that b-AP15 effectively activates the ISR. Co-treatment with NAC mitigated cell death and apoptosis induced by b-AP15, emphasizing the role of oxidative stress in triggering ISR in b-AP15-treated cells. NAC also restored normal actin filament structure in HeLa cells, as confirmed via fluorescence microscopy, highlighting NAC's protective role against b-AP15-induced damage. Future research will explore the exact mechanism underlying b-AP15-induced ISR activation.

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51. Synthesis and Magnetic Properties of NaCl type compounds: Na_5OsO_6

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In antiferromagnetic materials the spins of unpaired electrons are ordered in antiparallel arrangement with respect to their neighbors. In materials composed of triangular sub-lattice of magnetic ions the magnetic constraints cannot be fulfilled simultaneously which results in a phenomenon called geometric magnetic frustration. In ordered NaCl structure type composed of FCC arrangement of cations such triangles are present leading to inability of the magnetic spin interactions to align themselves due to the lattice structure. Alternatively, if all the exchange interactions in triangles are not of the same strength, stronger interactions will dominate the magnetic structure by lifting the competition. Our group has previously studied members that belong to this family with Os ions as the magnetic ion centers. Examples include Li_5OsO_6, Li_4MgOsO_6, Li_3MgOsO_6, $Li_3Ni_2OsO_6$, and Li_4NiOsO_6. The focus of this study is to further our understanding on the effect of crystal structure on geometric magnetic frustration. Na_5OsO_6 was synthesized using conventional solid state synthesis method under specific atmospheric conditions. Stoichiometric amounts of osmium(IV) oxide and sodium oxide were mixed into a homogenous mixture, pelletized, and then placed into an alumina boat. The boat was placed into a quartz tube and then into a tube furnace and heated to 300 degrees Celsius under argon gas flow for 12 hours and then under oxygen for another 12 hours at 700 degrees Celsius. This process was repeated until the sample is in its desirable phase. Powder x-ray diffraction (XRD) was employed in order to characterize the phase purity. Preliminary x-ray data has shown that the compound Na_5OsO_6, is possible to create using conventional solid-state synthesis. Employing superconducting quantum interference device (SQUID), temperature dependent magnetic susceptibility measurements were collected at the Ohio State University.

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52. Investigating the Effect of 2,6-diarylidene cycloalkanones on Akt and Integrated Stress Response

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Protein kinase B, also known as Akt, is a serine/threonine kinase that plays pivotal roles in many important cellular processes including growth and proliferation, survival, migration, and metabolism. Dysregulation of Akt has been associated with several human diseases including cancer making it a therapeutic target for cancer treatment with many small molecule inhibitors currently in clinical trials. Our laboratory utilizes commercially available Akt inhibitors to study the role of Akt in cancer cell survival. This work focuses on one such inhibitor, SC66 ((2E,6E)-2,6-Bis(4-pyridinylmethylene)-cyclohexanone). SC66 was first tested and published as an Akt inhibitor, with the study suggesting that treatment with SC66 inhibited Akt activity and resulted in reduced cell proliferation and apoptosis. However, our lab discovered that treatment with SC66 led to activation of Akt and the integrated stress response (ISR) in multiple cell lines. This work aims to understand the mechanism by which SC66 activates Akt and ISR, and to test whether SC66-induced Akt activation and ISR activation are interdependent. Using a cervical cancer cell line called HeLa, and a colorectal adenocarcinoma cell line called DLD1, we analyzed three structural analogs of SC66 to compare their outcome with that of SC66 treatment on HeLa and DLD1. Lysates of the cells treated with either the analogs or SC66 were analyzed by western blotting. Using specific antibodies that detect the activated form of Akt and ISR effector molecules, we determined that a substitution at the 4-position of the cyclohexanone with a phenyl group maintained the Akt and ISR activation, but replacing the carbonyl group with a hydroxyl group or replacing the cyclohexanone with a cyclopentanone abolished SC66-dependent Akt and ISR activation. For our second goal, we co-treated cells with SC66 and a known ISR inhibitor (ISRIB) to test if Akt activation is dependent on ISR activation. Lysates of the cells treated with SC66, ISRIB, or both were analyzed by western blotting. Our results suggest that Akt activation is independent of ISR activation in SC66-treated cells. The future experiments will focus on determining if SC66-mediated ISR activation is dependent on Akt activation. The findings of this study suggest that SC66 and its analogs cause cell death by triggering cellular stress and not due to Akt inactivation as previously proposed, thus shedding light on the correct mechanism of action of SC66.

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53. Iron-Containing Metal Organic Frameworks on Stainless-Steel as a Drug Delivery System

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In recent years, metal-organic frameworks (MOFs) have become increasingly viable for drug delivery applications due to their distinctive properties, including versatile architectures, extensive porosities, and high biocompatibilities. These unique characteristics assist in facilitating a controlled and sustained release of pharmaceutical compounds, providing desired therapeutic effects. Through the surface modification of stainless-steel drug eluting stents (DESs), MOFs demonstrate potential towards assisting in biomedical applications such as balloon angioplasty surgery. Herein, experimentation explores the surface modification of 316L medical grade stainless steel substrates (a common material for DESs) using an iron-containing MOF, MIL-88B(Fe). MIL-88B, composed of Fe trimers connected by terephthalate ligands, was chosen for potential stent coatings due to its biocompatibility and excellent drug-absorption capabilities. A solvothermal synthesis method was used to synthesize MIL-88B directly onto stainless steel surfaces, omitting the use of surfactants and mitigating potential interference in biological systems. The crystallinity and morphology of synthesized crystals was characterized using x-Ray diffraction (XRD) and scanning electron microscopy (SEM). These characterization methods gave further insight to the solvothermal synthesis and variation in thin film uniformity across the stainless-steel surfaces. Ibuprofen was used as a model drug for loading studies while release kinetics were monitored using UV spectroscopy and high-performance liquid chromatography (HPLC), respectively. Ultimately, this project aims to characterize the release kinetics of MIL-88B(Fe) on stainless steel surfaces to provide a novel drug-delivery system, diverging from polymer-based DESs with the intent of advancing atherosclerotic therapeutic strategies.

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54. Sodium Salicylate Activates Akt Signaling in a Colorectal Cancer Cell Line

Shayla Tran, Amber Peek, Gabriel Tan, Deepali Bhandari Ph.D.

Acetylsalicylic acid aka aspirin is an over the counter, non-steroidal, anti-inflammatory drug that has been linked to reduced occurrence of colorectal cancer, but the cellular mechanism(s) for its chemoprevention remains elusive. Cancer cells have altered metabolic demands due to the hypoxic environment and rapid proliferation rate that can induce proteotoxic stress. During this stress, cells activate an evolutionarily conserved signaling

pathway known as Unfolded Protein Response (UPR) which has been linked to the acquisition of malignancy and chemoresistance in cancer cells. Our group has shown that in addition to UPR, serine/threonine protein kinase Akt is also activated during proteotoxic stress in several cancer cell lines. The goal of this project is to test the activation of UPR effectors and Akt in a colorectal cancer cell line, DLD1. We treated DLD1 cells with sodium salicylate, a metabolic derivative of aspirin, and analyzed the activation status of Akt and the expression of various proteins involved in UPR signaling via western blotting. Our results indicate that Akt gets activated upon treatment with increasing concentration of sodium salicylate. For the UPR, sodium salicylate treatment differentially regulates the three branches of UPR signaling. Our current and future experiments are focused on investigating if Akt regulates the sodium salicylate-mediated differential activation of UPR. Together, this study will shed light on the molecular mechanism underlying the aspirin-associated chemoprevention in colorectal cancer.

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55. Morphology Control of Metal-Organic Frameworks

Dorsa Kamyab, Fangyuan Tian

Metal-organic frameworks (MOFs) are materials composed of metal ions/clusters linked by organic molecules, forming three-dimensional porous structures. They have been used in gas adsorption, separation, catalysis, drug delivery, and gene therapies. The size and morphology of these MOF materials play an important role in their applications. This study focuses on the shape control of PCN-222(Fe), a type of MOF, through various synthesis parameters. PCN-222(Fe) contains Zr clusters connected by Fe-metalloporphyrin ligands forming a one-dimensional channel with a micropore size of around 3 nm. By altering solvent types and ratios, reaction time, acids, temperature, and crystal collection methods, we aimed to achieve specific forms of PCN-222(Fe) crystals. Our experiments yielded a range of crystal morphologies, including variations in size and aspect ratios. These findings highlight the significant influence of synthesis conditions on the morphological characteristics of PCN-222(Fe) MOFs, which can be critical for their application-specific performance.

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56. Computationally Modeling Topological Insulators

Steven Le[1], Penghao Zhu, Ph.D.[2]

In recent years, topological insulators have garnered significant attention due to their promising applications in nanoelectronics and potential roles in quantum supercomputing. This study examines tight binding models of topological insulators; specifically focusing on the one-dimensional Su-Schrieffer-Heeger (SSH) model and the two-dimensional Qi-Wu-Zhang (QWZ) model. Using computational methods, I modeled the energy bands of these insulators by representing the real space Hamiltonians of each model and solving Schrödinger's equation. Through this approach, I was able to plot the energy spectra and analyze the wavefunctions, demonstrating that these materials conduct at their boundaries. I also analyzed these models after applying a dislocation to the lattice. Our results confirm the predicted edge state behavior of both the SSH and QWZ models as well as showing the unique properties of the QWZ model regarding dislocations. These findings contribute to a deeper understanding of the properties of topological insulators, providing a crucial step towards their practical implementation in advanced technological applications. This research underscores the importance of computational models in the study of quantum materials, highlighting their potential in the development of future nanoelectronics and quantum computing devices.

57. Preparation and Characterization of Lipid-Nanoparticle Assemblies Containing Hexanethiolate-and Phenylethanethiolate- Capped Pd Nanoparticles: Investigating the Effects of Catalyst Ligand Structures on Substrate-Catalyst Interactions

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This poster reports on the synthesis, characterization, and catalytic performance of lipid-nanoparticle assemblies (LNAs) containing hexanethiolate-capped palladium nanoparticles (C6-PdNPs) and phenylethanethiolate-capped palladium nanoparticles (PhC2-PdNPs). The study investigates how the structure of these ligands and their noncovalent interactions with styrene influence the catalytic activity and selectivity of palladium nanoparticles within lipid bilayers. The effects of varying the ratio of C6-PdNPs and PhC2-PdNPs are also explored by incorporating these nanoparticles in different ratios into DSPC liposomes to form stable LNAs. These assemblies and PdNPs are characterized using NMR, IR, UV-vis, DLS, and/or TEM, and their catalytic efficiency was evaluated through the hydrogenation of aromatic alkenes. The findings so far reveal that the encapsulation of PdNPs within the lipid bilayer environment significantly decreases the colloidal stability of LNAs. This requires the freshly prepared LNAs for the catalytic investigations. The catalytic performance of palladium nanoparticles is also evaluated using NMR after the isolation of the reaction products using chloroform extraction and a mini-column chromatography removal of lipids and PdNPs. This

research offers valuable insights into optimizing ligand structure and nanoparticle-lipid interactions for the development of more efficient catalytic systems.

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58. Unfractionated Heparin But Not Fondaparinux Promotes FGF23-Mediated Cardiac Hypertrophy in Chronic Kidney Disease

Bryan Y. Kang; Madison Thomas; Christian Faul

Fibroblast growth factor (FGF) 23 is a bone-derived hormone that stimulates renal phosphate excretion by binding fibroblast growth factor (FGFR) 1c and klotho on proximal tubular epithelial cells and activating extracellular signal-regulated kinase (ERK). In chronic kidney disease (CKD), FGF23 is highly elevated and contributes to cardiac hypertrophy by activating FGFR4 on cardiomyocytes in a klotho-independent manner, leading to phospholipase Cγ (PLCγ) signaling. Previously, we found that unfractionated heparin (UFH), which is used as an anticoagulant in hemodialysis patients, increases the FGF23-FGFR4 binding affinity and aggravates cardiac hypertrophy in animal models of CKD. In a recent binding assay we found that compared to UFH, short-chain heparin variants, including clinically used Fondaparinux sodium (FS), do not increase the FGF23-FGFR4 binding affinity. Here, we compared the effects of UFH and FS on FGF23-induced signaling and hypertrophy in cell culture models. We used rat chondrosarcoma (RCS) cell lines that express specific FGFR isoforms but lack klotho to study the activation of ERK and PLCγ by Western blotting. We found that in the presence of FGF23, UFH increased ERK signaling, while FS elevated PLCγ activity. We also co-treated primary rat cardiomyocytes with FGF23 and UFH or FS, followed by immunofluorescence microscopy and quantification of cell area. We found that UFH, but not FS, increased FGF23-induced hypertrophic cell growth. In future experiments, we will test the cardiac effects of FS injections in CKD animal models. We propose that FS serves as an alternative anticoagulant for the hemodialysis process that does not contribute to cardiac damage.

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59. No abstract submitted

60. Energy Extraction via Magnetic Reconnection in a Rotating Black Hole

Jose M. Pineda and Raid M. Suleiman

Relativistic reconnection is a very efficient mechanism of magnetic energy conversion and particle acceleration, thus a primary candidate to explain nonthermal emissions from pulsar wind nebulae, gamma-ray bursts, and active galactic nuclei. Recent studies have shown

magnetic reconnection as a viable mechanism for energy extraction in Kerr and Kerr-de Sitter black holes. Here, we build the mathematical framework to extend the relativistic magnetohydrodynamics of general relativity to matter in negatively curved spacetime. In particular, we highlight the effects of the cosmological constant (Λ) and its role in energy extraction via magnetic reconnection. We examine the analytical results of the efficiency of the energy extracted via magnetic reconnection.

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61. TiO_2-coated Plasmonic *Gold Nanoparticles* and *Gold Nanorods* as Photonic Nanoreactors

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We are working to synthesize various concentrations of *titanium dioxide* coated on *gold nanoparticles (AuNP)* with different sizes and *nanorods (AuNR)* for photocatalytic activity. When semiconductors such as *TiO_2* absorb light, electrons from the valence band (VB) transition to the conduction band (CB), creating holes in the VB and electrons in the CB. *TiO^2* benefit from the presence of *AuNPs* as electron trapping centers. So far, much of the work has been done with exciting TiO2 with UV light to understand the effects of AuNP as either core or satellite dopants. In another mechanism, *AuNPs* enhance electron movement and generate hot electrons through plasmon resonance by exciting them with visible light. *AuNRs* can be more effective than *AuNPs* due to their larger surface area, which improves reactivity by providing more active sites for electron and hole generation. We are particularly interested in understanding the role of TiO2 coating on the photocatalytic activity of plasmon resonance-enabled AuNP and AuNRs.

We hypothesize that *TiO_2-coated gold nanomaterials (TiO_2@AuNPs/AuNRs)* would undergo photocatalytic reactions by exciting the plasmonic bands of *AuNPs* and that the thickness of TiO_2 coating or size/shape of the nanoparticles would control the aggregation of *AuNPs*. For this research, we used Scanning Transmission Electron Microscopy (STEM) to characterize the synthesis results of *TiO_2@AuNP* and *AuNR*. Energy Dispersive X-ray spectroscopy (EDS) further confirmed the presence of *TiO_2@AuNPs* and *AuNRs*. The photocatalytic reaction on the material was observed by measuring the amount of hydrogen gas produced upon photoexcitation utilizing inline mass spectrometry.

Up to now, we discovered that the amount of *titanium tetra-isopropoxide (TTIP)*, which is a TiO_2, precursor in the synthesis process, controls the nanomaterials' *AuNP* aggregation rate not the thickness of the TiO_2 coating on *AuNPs*. Moreover, according to the results from the H_2 evolution experiment by mass spectrometry, *AuNPs with smaller sizes* were less efficient as photocatalysts than AuNPs with larger sizes. In future work, we will test the new hypothesis: "more efficient photocatalytic H2 evolution by the water-spitting reaction occurs from *AuNPs with* the greater size and controlled *aggregation* and *AuNRs* with a thin coating of TiO_2".

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62. Lipid-binding Activity of Single Cysteine Containing Apolipoprotein AI and Relevance in Cardiovascular Disease

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Cardiovascular diseases (CVD) are a group of diseases with multifactorial risk factors and are considered the #1 killer in the US and elsewhere in the world. HDL plays a role in promoting cholesterol efflux from macrophages and removing cholesterol from the arterial intima to the liver in a process called reverse cholesterol transport. The Framingham Heart Study proposed the 'HDL hypothesis', which states that high HDL cholesterol correlates with protection against CVD, while low HDL levels pose a risk factor for developing CVD. After several clinical trials that led to poor outcomes despite raising HDL levels, lipoprotein researchers proposed the importance of functional HDL, rather than focusing on HDL levels. In our lab, we examined the major protein component of HDL, apolipoprotein AI (apoAI). We based our studies on $apoAI_{Milano}$ and $apoAI_{Paris}$, two naturally occurring variants whose carriers do not express clinical signs of CVD despite their low levels of HDL. There are no Cys in wild type apoAI. We hypothesize that the presence of a single Cys in a segment that is believed to bear an ability to transition between an unstructured loop and a helical structure depending on the lipid content of the HDL in apoAI, alters the lipid binding and/or antioxidant ability of apoAI. To test this hypothesis, we designed a series of single Cys variants in the segment between 126 and 158 of apoAI (L126C, A130C, L134C, A152C, A154C, A158C), over-expressed and purified the recombinant protein bearing a hexa-His tag at the N-terminal end in a bacterial expression system. Preliminary SDS PAGE analysis under reducing conditions revealed a major band around 26 kDa for all variants; under non-reducing conditions, variants with Cys located towards the edge of the loop (ie, L126C, A130C, A154C and A158C) displayed a mixture of disulfide bonded dimers and monomers, while those with Cys in the middle of the loop segment (L134C and A152C) appear to exist in predominantly non-disulfide bonded monomeric state. It is not known at this point if the differential effect noted with these mutants is the consequence of storage conditions. Next,

we determined their ability to solubilize lipids in phospholipid vesicle solubilization assay under reducing and non-reducing conditions. All mutants displayed a higher rate of lipid binding in the reduced state compared to WT apoAI. Under non-reducing conditions, all mutants (except L134C) appeared to react faster than WT apoAI. Further studies are in progress to confirm these findings and to separate the monomers from dimers to determine their effect on the lipid binding activities. This will be followed by assessment of the relative antioxidant activities of these mutants, which will aid in linking with their lipid binding activity. Taken together, these studies will contribute significantly to our understanding of the pleiotropic effect of HDL and its role in mitigating the risks associated with CVD.

63. The Analysis of the Density of the Sequence tan(n)

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The sequence tan(n) is a list of infinitely many terms, where each input “n” is a positive integer. The goal of this project is to determine if the sequence tan(n) (intersected with [0,1]) is dense in the interval [0,1]. It’s known that the sequences sin(n) and cos(n) are dense on the interval [0,1]. We were curious if the sequence tan(n) was also dense on the interval [0,1]. We approached our problem from two different sides: one focused on examining the outputs of tan(n) that fall in [0,1] and determine if the error converges to 0 as values increased; the other approach followed a similar line of thinking of the sin(n) proof however focusing on the outputs from [0,1]. We designed a code that calculated the errors of consecutive difference in tan(n), allowing for us to see a possible pattern in the calculations. For the second method we utilized a specific case of a lemma to find that the sequence tan(n) is dense on the interval [0,1] under that assumption.

64. Organelle Trafficking Defects in the Retinal Pigment Epithelium of Macular Degeneration Model

Lindsay Odell, Valencia Fernandes, Aparna Lakkaraju

The retinal pigment epithelium (RPE) is a uniquely polarized epithelium that sits between the photoreceptors and choriocapillaris, and plays an important role in maintaining the health of the photoreceptors and retina. Macular degeneration causes loss of central vision and several studies including the Lakkaraju lab, have shown that in models of macular degeneration (age-related macular degeneration (AMD) and Stargardt inherited macular degeneration), excess cholesterol and ceramide accumulate within the RPE, causing increased acetylation of tubulin. Post translational modifications of microtubules like acetylation have significant impact on the cellular transport of organelles such as early endosomes, late endosomes, mitochondria, and lysosomes. In this project, we aim to study

how aberrant increase in acetylated tubulin affect these organelle trafficking within RPE. Insight into this will help us understand how damage in RPE trafficking plays a role in AMD. Retinal pigment epithelial (RPE) cell line ARPE-19 were treated with U18666A to induce cholesterol accumulation and Tubacin (positive control), a selective HDAC6 inhibitor. Several organelles like early endosomes and lysosomes were studied using live spinning disc microscopy imaging. The data were further corroborated in wild type and Abca4 knockout mouse cryosections. Dynamic microtubule transport of organelles play an essential role in maintaining proper RPE functions and overall retinal health. Increase in cholesterol accumulation disturbs this trafficking, affecting several organelle functions within the RPE. Our data focuses on studying these organelle trafficking within the diseased RPE.

65. Model Calculations for Dark Matter Admixed Neutron Stars

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An aspect of neutron stars that is not well understood is the composition of the stellar matter in its interior. Examining oscillation frequencies of these stars, either as isolated objects, or the ringdown after neutron star mergers, is a way of checking possible hypotheses with regards to the internal composition and driving forces of the oscillation. In particular, we consider neutron stars containing a fraction of dark matter, a form of matter that is predicted by cosmology and other astrophysical data. As a guiding model, we consider a compact star with nuclear matter through the lens of nuclear relativistic field theory. Using a mean-field Lagrangian and the tools of statistical mechanics, we can apply the Tolman-Oppenheimer-Volkoff (TOV) equations to obtain the structure of the star and the Chandrasekhar equations to obtain the radial oscillation modes. Furthermore, it is conjectured that gravitational waves from non-radial oscillations can be detected on Earth by the LIGO instrument. The combined use of nuclear field theory and asteroseismology can help shed light on the presence of dark matter in neutron stars.

This project is supported in part by the Gisela and Wilfried Eckhardt Endowment for Physics and Astronomy, the John Turner Summer Research Assistantship, and US National Science Foundation Grant PHY-2310001.

66. Magnetic Characterization of Diluted Iron Phthalocyanine Thin Films using Co-Deposition

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Iron phthalocyanine (FePc)-based materials form quasi-one-dimensional (1D) chains through π-π stacking interactions and exhibit strong exchange coupling and anisotropic magnetic properties. This study focuses on synthesizing a system where FePc is diluted with its metal-free counterpart phthalocyanine (H2Pc) to understand the influence of FePc's unpaired electron on the overall magnetic relaxation processes in mixed films, and how the interactions in such systems compare to their undiluted counterparts. A preliminary analysis was conducted on FePc (67.8 nm) and H_2Pc (100 nm) thin films deposited onto silicon substrates, with a focus on examining their surface topology, composition, and magnetic hysteresis behavior. These measurements provide a scaffolded insight of magnetic properties in co-deposited iron phthalocyanine.

This project is supported in part by the National Science Foundation and the Partnership for Research and Education in Materials (PREM) under NSF Grant No. 2122199.

67. Optimizing the Transfer and Exfoliation of Large-Area Monolayer 2D Materials

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The rise of research and development of 2D materials has led to its use in nanoelectronics. Certain materials like monolayer *Transition metal dichalcogenides (TMDs)* are more favorable for nanoelectronics due to their optical and electronic properties. Current research towards monolayer *TMDs* are based on improving the ability to exfoliate bulk crystals to create High output and High-quality monolayers at a large scale. A gold-assisted method helps with the output and quality of the monolayers but current etching methods to remove them from the gold has a high risk of damaging them. The current goal of this project is to preserve the size and quality of the monolayers during the etching process by testing multiple experimental methods to see which method is most viable in preserving the monolayer quality. This report will showcase the progress made towards the project goal by outlining the experimentation process and compare the results of the different exfoliation methods using different characterization techniques. The steps taken during this project will help increase the viability of using gold substrates as a mediator for the exfoliation of van der

Waals bulk crystals to create monolayers of *TMDs* for use in quantum information science and nanoelectronics.

This work was performed at the National Science Foundation Materials Research Science and Engineering Center at Northwestern University under Award No. DMR-2308691.

68. Surface Morphology of Bithermal Copper Phthalocyanine Thin Films

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The performance of many semiconducting thin films for photovoltaic and spintronic applications is determined by the interface and surface morphology. Structural control of copper phthalocyanine thin films can be achieved through varying substrate deposition temperature. By consecutively depositing the same material at two different substrate temperatures, referred to as bithermal deposition, novel surface structures are produced and characterized with x-ray diffraction and atomic force microscopy. The x-ray diffraction spectrum has a prominent Bragg peak for all samples, but stronger associated Laue oscillations occur for bilayer samples compared to room temperature deposited copper phthalocyanine thin films. The atomic force microscopy shows two distinct surface morphologies that are unique to the bithermal deposition technique. Via the height-height correlation function, the bithermal samples show lower long-range surface roughness and longer correlation length than room-temperature deposited copper phthalocyanine thin films.

This material is based upon work supported by the National Science Foundation under Grant No. 2122199 through the Partnership for Research and Education in Materials.

69. Optical Tweezers: Assembly & Force Calibration

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Optical Tweezers are an optical apparatus used in the biophysical world to hold and manipulate microscopic particles. Optical Tweezers, also known as an optical trap, trap particles at the trap center at the waist of a focused beam using the gradient force. Through carefully assembling the optical tweezers by ensuring all optical lenses are positioned properly, aligning the laser beam using readouts from our quadrant photodiode (QPD), and making all corrections for sample slide specifications, micron sized beads have been successfully trapped. Continuing my research, I will be working on code to fully automate

the piezo stage movement and pull data from the QPD through an external data acquisition device. I will then be attaching beads to kinetoplast DNA (interlocked minicircle discs), trapping one of the kinetoplast attached beads, and having my stage move in a controlled manner to stretch the kinetoplast. My goal with stretching kinetoplasts will be to measure the elastic response of their interlocked ring bonds (catenane bonds).

This project is supported in part by Office of Research and Economic Development (ORED) and the National Science Foundation (grant 2105113).

70. Structural Phase Transition Induced by Molecular Substrate Interactions

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Phthalocyanine thin films have unique properties in various electronic devices and sensors that are not commonly found in traditional semiconductors. These electric, optical, and magnetic properties are strongly dependent on their film structure including their crystalline size and orientation. As previously shown, when the substrate molecular interaction is stronger than the molecule-molecule interaction, the anisotropic molecule has its plane lying flat on the substrate surface. In contrast, if the molecule-molecule force dominates, the phthalocyanine molecules arrange in a standing configuration. For some substrates like gold surfaces, the roughness can also trigger this transition from flat lying to standing configuration. Here, we examine thin films of copper phthalocyanine deposited onto gold coated silicon substrates to show quantitative data of this molecular orientation transition using x-ray diffraction and atomic force microscopy. The gold roughness is varied with several methods and measured before a single co-deposition of phthalocyanine.

This material is based upon work supported by the National Science Foundation under Grant No. 2122199 through the Partnership for Research and Education in Materials.

71. Atomic Force Microscopy Imaging of Topologically Complex DNA

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Atomic force microscopy (AFM) is widely used to provide high-resolution images at the nanoscale of DNA molecules. Here, we present examples of AFM used to analyze two types of topologically complex DNA: single-stranded DNA and kinetoplast DNA. Denaturation reactions on linear λ DNA produce molecules with regions of single-stranded DNA (ssDNA), which shows a marked decrease in persistence length compared to double-stranded DNA (dsDNA). Kinetoplast DNA (kDNA), from the mitochondria of the trypanosomatid *Crithidia fasciculata*, is a unique structure made up of thousands of topologically interlocked circular

DNA molecules, most of which are minicircles. We analyze AFM images of XhoI-digested kDNA to determine the persistence lengths of minicircle chains (polycatenanes) and the density of minicircles in the network at various stages of digestion.

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72. Solution to TOV equations

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Solutions of the Tolman-Oppenheimer-Volkoff(TOV) equations describe the internal structure of a non-rotating neutron star in hydrostatic equilibrium. In order to obtain these solutions, for instance in the form of mass-radius relationships, an equation of state (EOS) needs to be specified. Due to the compactness of neutron stars, the EOS has to be obtained in a relativistic framework. Ideally, it is based on a model of particle interactions, thus elucidating the impact of microscopic quantum states on the macroscopic properties of neutron stars and the matter within. We wrote a program, which computes solutions of the TOV equations using simple EOS equations, then graphs these solutions in real time. It is thus a useful tool for students aiming to learn and understand concepts of neutron star physics in an interactive way.

This Project is supported in part by Daniel and Grace Lim and Keung Lai Luke Assistantship for funding.

73. A Cu-Catalyzed Hydrothiolation of Azetines

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The covalent bonding of carbon-sulfur (C-S) bonds is essential to life. The construction of C-S bonds has garnered attention amongst organic chemist due to their prevalence in significant bioactive compounds.

Among these, compounds containing the N,S-acetal scaffold are significant and abundant in numerous biologically active compounds including drugs, natural products, and medicinally important compounds. Compounds with the *N,S*-acetal scaffold contain a range of therapeutic properties: anticancer, anti-inflammatory, anti-bacterial, anti-schizophrenic, anti-malarial, and more. Additionally, *N,S*-acetal compounds exhibit increased pharmacokinetic properties making accessibility of these compounds a noble and worthwhile pursuit. We aim to advance transition-metal catalyzed hydrothiolation of azetines in a regioselective manner utilizing thiophenols to improve the accessibility of *N,S*-

acetals. Azetine is synthesized using a shlenk line and the hydrothiolation with varying thiophenols is carried out in the glovebox. The hydrothiolation is catalyzed using earth-abundant copper catalysts with the resulting products analyzed using NMR and mass spectroscopy. The reaction conditions are optimized via solvent, temperature, and ligand screens. Our findings revealed that ligand choice diverges regioselectivity, forming two hydrothiolation products with either alpha insertion or beta insertion. Scoping of electron-withdrawing groups (EWG) and electron-donating groups (EDG) revealed an additional switch in regioselectivity. Specifically, we noted that electron-withdrawing groups inserted at the alpha position while electron-donating groups (EDG) resulted in beta-inserted products. These changes in regioselectivity provide insight into a proposed reaction mechanism. For future work, we anticipate carrying out mechanistic studies by synthesizing deuterated thiophenol. We anticipate expanding the azetine scope as we hypothesize that azetine bearing various aryl, EDG, and EWG substituents can be used. Given that N,S-acetal motifs are abundant in antibiotics such as penicillin and amoxicillin, developing a rapid and robust synthetic pathway will significantly facilitate the creation and discovery of new medicinal compounds.

The project is supported by UCI Graduate Division.

74. Inhibition of Butyrylcholinesterase by Fmoc-Lys-O^- Analogs for the Potential Treatment of Alzheimer's Disease

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The two cholinesterases, butyrylcholinesterase (BChE) and acetylcholinesterase (AChE) are suggested to play a major role in Alzheimer's Disease (AD). Individuals with AD show an increase in BChE activity while minimal change in AChE activity, and this increase in BChE activity is suggested to deplete the pool of the neurotransmitter, acetylcholine, leading to dementia. Based on these observations, BChE inhibitors are sought to elevate acetylcholine levels and increase cognitive function. We previously found that 9-fluorenylmethoxycarbonyl (Fmoc) based amino acids selectively inhibited BChE. The lysine-based compound, Fmoc-Lys-O^-, was one of the more potent inhibitors. The structural similarity of the cationic ammonium group relative to the cationic trimethylammonium group of acetylcholine was suggested to contribute to interactions with the enzyme. While both compounds contain a positively charged group, the methyl groups in acetylcholine could contribute to favorable binding interactions. To test this model, we investigated di- and trimethylated Fmoc-Lys-O^- analogs as inhibitors. Enzyme activity was measured using commercially available BChE and UV-Vis absorbance assays. Initial rates for activity were determined for a series of inhibitor concentrations, and these values were used to calculate the IC_{50} value, the value at which the enzyme activity is half the maximal activity observed without the inhibitor in the

reaction. The IC50 values of Fmoc-Lys-O-, the di-, and trimethylated analogs were 19 ± 3 mM, 41 ± 9 mM, and 8 ± 1 mM, respectively, where lower values indicate more potent inhibition. Selectivity experiments with AChE, trypsin, and chymotrypsin showed the trimethyl compound weakly inhibited AChE but was more potent for BChE, and no inhibition of the other enzymes was observed under the conditions tested. The results suggest that the trimethyl lysine compound may be a better inhibitor compared to the starting Fmoc-Lys, but a dimethyl analog is less effective. Computational docking calculations are currently underway to evaluate the structural features that may contribute to the complex behavior observed when increasing the number of methyl groups in the Fmoc-Lys background. Overall, these studies are aimed identifying more potent Fmoc-based compounds as BChE inhibitors and furthering our understanding of enzyme-small molecule interactions important for inhibition.

75. Investigating the Reactivity of α-Boryl Radicals in Asymmetric Ni-Catalyzed Cross-Coupling Reactions

Zachary Hill, Jason Haddadin, Dr. Julie Wahlman

Metal-catalyzed cross-coupling reactions have been instrumental in the formation of new carbon-carbon bonds. In contrast to traditional cross-coupling, many examples of cross electrophile couplings haven been developed in the presence of a nickel catalyst and a stoichiometric reductant. Additionally, chiral ligands can be utilized to dictate the enantioselectivity of a carbon atom during the bond forming process and allowing for the synthesis of one enantiomer over the other. Our aim is to develop a highly enantioselective reductive cross-coupling reaction that couples a-boryl radicals with alkenyl bromides to form chiral allylic boronates. This product is versatile and can be elaborated to allylation products that contain two adjacent stereocenters. Our focus currently lies in the use of α-chloro boronic pinacol esters (Bpin) as electrophiles. We have successfully synthesized an alkyl a-chloro Bpin substrate as verified by ^{1}H NMR spectroscopy, and our efforts are now focused on improving the yield and enantioselectivity of the target cross-coupling reaction through optimization efforts. We are also investigating the use of phenyl NHP esters with adjacent MIDA boronates as alternate a-boryl radical sources to expand the scope of our reaction products.

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76. Mutation of Activin Receptor II A to Increase Binding Efficiency in Ligands Activin C and E

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The Transforming Growth Factor β (TGFβ) are a large family of ligands that play a diverse role in biological processes such as tissue homeostasis and biological development. Cases of TGFβ dysregulation can occur in various pathologies like infertility, fibrosis, osteoporosis, and cancer. Ligands signal via the binding of 2 type I receptors and 2 type II receptors which are divided into 7 type I receptors and 5 type II receptors. Activins are a specific subclass of TGFβ family ligands; currently the subclass includes activin A (ActA), ActB, ActC, ActE, with myostatin and GDF11 as distant members. For a majority of the activin class members, the high affinity ligand:type II receptor interactions of other members are characterized, while less potent ligands ActC and ActE have a lower affinity for type II receptor binding. With this project we aim to use the type II receptor, ActRIIA, and create 8 different single mutation variants of the receptor protein with the goal of increasing the affinity of receptor protein to ActE ligand. We hypothesize the alterations to the receptor interface can increase affinity to ActE and ActC, creating a more specific and targeted receptor-ligand binding. Using bio-layer interferometry (BLI) and cell-based luciferase assays we can monitor the affinity of each receptor ligand pairing. Further understanding the ActRIIA/ActE or ActC interaction can help provide better insight to ActE and ActC cellular signaling abilities. Increased affinity can also create avenues for therapeutics in creating anti-activin E and anti-activin C for inhibiting ActC/E activity.

Five Key Words:
Transforming Growth Factor β (TGFβ), Signaling, Homeostasis, Affinity, Mechanism

77. Fabrication of Single Layer Nano/Microsphere Templates Using Dry Rubbing Method

Alan Mejia, Dr. Jiyeong Gu

Various nanoscale thin films are fabricated using hexagonally close-packed single-layer nano/microsphere templates. Thin magnetic layers on such templates result in curved nanomagnetic thin films. The geometry of thin film induces unique magnetic domains, which have potential applications in data storage devices, spintronics, and biological or chemical sensors. While several techniques exist for creating nano/microsphere templates, this study employs a manual rubbing method using a polydimethylsiloxane (PDMS) stamp to quickly achieve hexagonally close-packed single layer template. 30 nm thick Permalloy (Py) or Samarium Cobalt (SmCo), nanocap structures were made on top of nano/microsphere template by sputtering deposition. Spheres with diameters ranging from 800 nanometers

(nm) to 10 micrometers (μm) were used. Also, the spheres and substrates with various types of materials are tested to optimize the conditions to obtain uniform coverage of spheres in large area of the substrate. Using a Scanning electron microscope (SEM), images were taken to show differences in coverage and stacking among the various templates. Among various templates made, two templates, one for 800 nm polystyrene spheres (PS) and another for 10 μm silicon dioxide (SiO_2) spheres, achieved extensive substrate coverage, although notable stacking issues were observed using the SEM. When reusing the same PDMS stamp for two samples of 10 μm SiO_2, the first sample exhibited extensive coverage with considerable stacking, while the second sample displayed a smaller, more concentrated area of single-layer particles. After examining the PDMS stamps under an optical microscope, it was observed that a substantial number of particles had been retained, with some layers stacking on top of each other. Upon the second use, most of the multiple layers were rubbed off, leaving only a single layer of particles on the PDMS stamp.

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78. Identification of Lipoprotein-Binding Sites Using Cyanogen Bromide Generated Peptides of Apolipophorin III

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Apolipophorin III (apoLp-III) from *Locusta migratoria* is an exchangeable apolipoprotein that provides the capability for long-distance flight in insects by utilizing a lipoprotein shuttle mechanism. The protein is made of a bundle of five amphipathic α-helices, which reposition to allow lipoprotein binding. ApoLp-III is an excellent model system for structure function studies of apolipoproteins. In a previous study, apoLp-III was cleaved into two peptides to produce an N-terminal (NT) peptide comprising helix 1 to 3 (NT_{H1-3}) and a C-terminal (CT) peptide of the remaining two helices (CT_{H4-5}). Only the NTH1-3 peptide was able to bind to lipoproteins, similar to the intact protein. This suggests that specific amino acid residues necessary for lipoprotein binding reside within helices one to three. In the current study, two novel peptides of apoLp-III were generated to determine the location of lipoprotein binding sites in the first three helices. By employing site-directed mutagenesis, glutamine-68, positioned at the end of helix two, was changed to methionine, facilitating cyanogen bromide cleavage. Successful mutation was confirmed through DNA Sanger sequencing. The mutant protein apoLp-III-Q68M was expressed in *E. coli*, then purified by size-exclusion chromatography and reverse-phase HPLC, yielding 10 mg per L culture. A 1:100 molar ratio

of protein to cyanogen bromide was incubated for 24 h to cleave the protein, producing an NT peptide comprising helix 1 and 2 (NT_{H1-2}) with an expected mass of 7438.31 Da and a CT peptide comprising helix 3 to 5 (CT_{H3-5}) with an expected mass of 9980.87 Da. SDS-PAGE revealed a band ~10 kDa, likely representing CTH3-5. The smaller peptide was not visible, which could be due to poor staining or its small size. Since approximately 50% of apoLp-III-Q68M was cleaved, the digestion conditions need to be improved. Reverse-phase HPLC will be used to separate the two peptides, which will be confirmed by SDS-PAGE. The lipoprotein-binding properties of each peptide will then be tested using modified low-density lipoprotein (LDL) and measuring the level of LDL aggregation. If the NT_{H1-2} peptide provides protection, then the lipoprotein-binding properties reside in the first two helices. If CT_{H3-5} is capable of providing protection against LDL aggregation, then helix 3 may be most critical. To locate the precise location of the lipoprotein binding site, peptide synthesis containing critical segments of apoLp-III based on the cyanogen bromide generated peptides may be required.

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79. Title: Creating a High Sensitive Microwave Interferometric Ferro-Magnetic Resonance Measurement System Set-Up

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Conventional Ferromagnetic Resonance (FMR) plays an important role in measuring the magnetic dynamics and the fundamental magnetic properties of magnetic materials. An Interferometric Ferromagnetic Resonance (IFMR) utilizes interferometric techniques (Destructive interference) to reduce the noise and the background to achieve a higher signal to noise ratio. In the research using this new IFMR technique, it's used to enable higher sensitivity to reveal the magnetic materials in the nanometer scale and their quantum properties. The IFMR technique is executed using Attenuator and Phase Shifter which matches the amplitude and sends the opposite phase in order to have max destruction of the signal. The set-up also utilizes a low-noise amplifier (LNA) which amplifies the signal and an Arbitrary Wave-Form Generator (AWG) to apply a low-frequency modulation magnetic field which with the Vector Network Analyzer (VNA) helps to reduce noise. In order to see if these noise subtraction techniques are subtracting significant noise from the FMR signal, enough to measure on the nano-dot scale, Yttrium Iron Garnet (YIG) is measured using the conventional FMR set-up and compared to when it's measured on the IFMR set-up.

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80. Conformational Study of Lipid Bound Apolipoprotein A-I by Pyrene Excimer Fluorescence

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Atherosclerosis is a chronic inflammatory disease that involves the buildup of plaques within arteries, ultimately leading to cardiovascular disease. High-density lipoproteins (HDL) play a critical role in reverse cholesterol transport, and apolipoprotein A-I (apoA-I) is the primary protein component of HDL. This 28 kDa protein is comprised of an N-terminal (NT) helix bundle domain and an unstructured C-terminal (CT) domain, which provides high lipid-binding affinity and self-association properties. The protein undergoes a large conformational change when switching from a lipid-free to a HDL-bound state. To better understand the structural changes of the CT helices upon lipid binding, pyrene excimer fluorescence was employed. Pyrene is a spatially sensitive probe and displays excimer fluorescence when two fluorophores are spatially proximal. A series of mutant proteins were engineered in which one NT residue (Ser-25) or three CT residues (Ser-201, Ser-231 and Gln-216) were replaced by cysteine. Mutants were expressed in *E. coli* and purified via Ni-affinity and gel filtration chromatography. The mutants were labeled with 5x molar excess of tris(2-carboxyethyl) phosphine (TCEP) and a 10x molar excess of N-(1-pyrene) maleimide (NPM) in the presence of 3 M guanidine HCl. The reaction mixture was incubated at 37°C for 16 h. Ni-affinity chromatography was employed to remove excess TCEP and NPM. Labeling efficiency was determined by the absorbance at 280 nm for protein concentration and 345 nm for NPM. The pyrene-to-cysteine stoichiometry for S25C was 1.04, while for S201C, Q216C and S231C, values of 0.85, 0.72, 0.64, were obtained. Fluorescence spectra of lipid free apoA-I showed a gradual decrease in pyrene excimer intensity in the order S25C >S201C>Q216C>S231C. This suggests that the distance between the CT helices increases from helix 8 to 10. To study the alignment of the CT helices in the lipid bound state, reconstituted HDL (rHDL) was generated with 1-palmitoyl-2-oleoyl- glycero-3-phosphocholine using pyrene labeled apoA-I. Protein and lipid were mixed at a ratio of 2.5: 1 and incubated with sodium deoxycholate (NaDC) at 37 °C for 1 h, and dialyzed against sodium phosphate buffer to remove excess NaDC. KBr ultracentrifugation was performed to isolate rHDL. Native PAGE showed a band around 180 kDa with a diameter of 8.6 nm (S25C) and 9 nm (S201C), which is similar to the typical 10 nm diameter reported for wild-type apoA-I. The emission fluorescence spectra of pyrene-labeled rHDL revealed a significant excimer formation for the S25C mutant, while S201C displayed reduced excimer intensity. Emission fluorescence spectra of pyrene labeled rHDL with the two other pyrene labeled

cysteine mutants will be carried out to gain further insight into the orientation of CT helices upon lipid binding, providing insight into the conformational changes of the CT domain.

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81. Microcrystal Electron Diffraction of a Thin Layer of Cu-Phthalocyanine on Suspended Graphene

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This study investigates the correlation between crystal structure and electronic properties of copper phthalocyanine (CuPc) on graphene/hexagonal-boron nitride (Gr/h-BN) heterostructures. Having previously shown tremendous potential for biomedical diagnostics, photocatalysis, and hydrogen production, we aim to employ a three-pronged approach combining Microcrystal Electron Diffraction (MicroED), 4D-STEM (four-dimensional scanning transmission electron microscopy), and X-ray diffraction to characterize CuPc thin films' molecular arrangement, orientation, and lattice structure. The low-flux beam capability of micro-ED allows non-destructive analysis of these sensitive organic structures, overcoming the limitations of traditional TEM techniques. Concurrent electronic transport measurements on Gr/h-BN devices before CuPc deposition, including magnetoresistance, gate-dependence, and differential conductance at low temperatures (down to 300 mK) and high magnetic fields (up to 12 T) will be conducted. Preliminary data suggest a transition from positive to negative magnetoresistance upon CuPc deposition, indicating significant changes in electronic structure, as well as an improvement of the mobility of the Gr/h-BN initial device. By correlating the detailed structural model with electronic properties, this research provides crucial insights for optimizing bio-inspired devices and validates advanced electron microscopy techniques for characterizing organic-inorganic heterostructures.

Funding for this project was provided by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences under Contract No. DESC0018154 and Cal State Long Beach and Ohio State University Partnership for Education and Research in Hard and Soft Materials, a National Science Foundation PREM, under Grant No. 2122199.

82. Magnetic Cycles of Oscillating Red Giants in Eclipsing Binaries

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Although magnetic activity cycles are well-established in main sequence stars, red giant branch magnetic activity cycles have not been demonstrated to date. Indeed, most red giants are too slowly rotating to characterize, but giants with short rotation periods due to binary interactions offer readily detectable rotation rates, with magnetic field variability potentially detectable using asteroseismology. If the dynamo mechanism operates in red giants as it does in main sequence stars, there should be a relationship between these rotation periods and magnetic cycle period. Here, we investigate potential magnetic cycle variability from observed variations in ν_{max} and $\triangle\nu$ from Kepler among a handful of rapidly-rotating giants in binary systems. We also present analysis of asteroseismic variability from TESS, which significantly extends the time baseline. With this data, we place limits on the magnetic cycle periods for these stars, situating them in a period-cycle diagram. A subset exhibit asteroseismic variability on timescales longer than the rotation period but shorter than the expected magnetic cycle period from extrapolations of main sequence stars, which may be analogous to biennial solar magnetic field variability. The present analysis offers motivation for continued monitoring of Kepler targets with TESS and PLATO missions to provide constraints on decades-long magnetic cycles in giants.

Data Source Acknowledgement

This paper includes data collected by the Kepler mission and obtained from the MAST data archive at the Space Telescope Science Institute (STScI). Funding for the Kepler mission is provided by the NASA Science Mission Directorate. STScI is operated by the Association of Universities for Research in Astronomy, Inc., under NASA contract NAS 5–26555.

This paper includes data collected with the TESS mission, obtained from the MAST data archive at the Space Telescope Science Institute (STScI). Funding for the TESS mission is provided by the NASA Explorer Program. STScI is operated by the Association of Universities for Research in Astronomy, Inc., under NASA contract NAS 5–26555.

83. Exploring quantum spin liquid fluctuations in a Kitaev material through photo excitations of carriers

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The Kitaev Model provides an exactly solvable model for materials with a honeycomb lattice and strong spin-orbit coupling. One prediction of the Kitaev Model is an exotic ground state called a quantum spin liquid, a degenerate state that results from frustration. This has sparked in the recent years interest in searching for materials that exhibit such behaviors, and -RuCl3 has emerged as a promising candidate. We seek to expand on our prior work that has observed signature of another possible ground state for this material, a long range ordered magnetic state, introducing now to our guarded high impedance setup, the photo excitation of charge carriers, which may allow us to tune into a regime of quantum spin liquid fluctuations.

Grant Support: Funding for this project was provided by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences under Contract No. DESC0018154 and the Cal State Long Beach and Ohio State University Partnership for Education and Research in Hard and Soft Materials, a National Science Foundation PREM, under Grant No. 2122199.

84. Towards a complete merger history of the Milky Way using APO-K2 asteroseismic ages

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The Lambda Cold Dark Matter (L-CDM) model of cosmology predicts that the galaxy in its current state formed via the aggregation (or “cannibalism”) of nearby satellite galaxies. The remnants of these galaxies can be observed today in the Galactic halo, a spherical distribution of stars orbiting the center of the galaxy. Recent work has questioned whether the Milky Way has a typical merger history, based on the chemical composition of stars in the halo compared to simulations. To shed further light on the formation history of our galaxy, we aim to place age constraints on the galaxy's various substructures to determine how old they were when they initially merged with the Milky Way. We have identified several substructures in the APO-K2 dataset using the kinematic and chemical attributes of stars in the halo. The ages of these stars were also determined using mass estimates from K2 asteroseismology. Using a Markov-Chain Monte Carlo (MCMC) analysis, we have obtained preliminary age distribution estimates of the stars in four halo substructures. The derived

age distributions will allow estimates of merger times in future work, placing these substructures on a timeline of the Galaxy's formation history.

This project is supported in part by the 2024 CSULB Student Summer Research Award.

85. Fabrication of van der Waals heterostructures of graphene/PtTe2

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This study presents a novel approach to fabricating *van der Waals* heterostructures composed of *graphene* and *platinum ditelluride (PtTe2)*. *Van der Waals* heterostructures have garnered significant attention due to their unique properties and potential applications in next-generation optoelectronic devices. We employed mechanical exfoliation to create atomically thin layers of *graphene* and *PtTe2*, which were subsequently stacked to form a heterostructure using stamp transfers. Our results demonstrate successful layer-by-layer assembly and preservation of individual material properties. We plan to perform electronic transport measurements on the *graphene/PtTe2* heterostructures and test graphene as a robust contact electrode to PtTe2.

Grant Support: Funding for this project was provided by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences under Contract No. DESC0018154 and the Cal State Long Beach and Ohio State University Partnership for Education and Research in Hard and Soft Materials, a National Science Foundation PREM, under Grant No. 2122199.

86. Peakbagging Rotating Kepler Giants

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The way stellar dynamos work, and consequently magnetic fields, in main sequence stars (those stars converting hydrogen into helium like the Sun) is not fully understood by the astrophysical community at this time. What is known, however, is that the magnetic fields of main sequence stars vary over time in a cycle based on the star’s rotation rate and internal convection—for the Sun, the magnetic cycle has a period of 11 years. While there exists some indication that there may be magnetic cycles for red giant stars (a later stage of stellar evolution after the main sequence with a significantly different stellar structure), it is not clear if these cycles have the same dependence on stellar rotation and convection as in main sequence stars.

Magnetic field variations can cause changes in the surface brightness and shifts in the internal oscillation frequencies of the star, which can be detected using photometry and asteroseismology respectively. Here, we demonstrate the promise of time-resolved data from NASA's Kepler space mission to be used as asteroseismic indicators of magnetic activity in giants. First, we present a sample of giants with stellar parameter information required to compute the oscillation frequencies as determined by a literature search. We then use open-source Bayesian software to determine the asteroseismic frequencies, and, using a test case, show that these frequencies are consistent with previous determinations in the literature. Next, we demonstrate that we are able to extract statistically significant frequencies as a function of time. In future work, we will expand this methodology to the larger sample in order to search for magnetic cycle variability in giants.

This project is supported in part by the Google Summer 2024 Assistantship.

87. h-BN Encapsulation of Atomically Thin Layers of PtTe2 for electronic transport Measurements at Low Temperatures

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PtTe2 has been demonstrated to have interesting topological properties. It's band structure presents different Dirac-like dispersions that host type-II Dirac fermions as well as chiral surface states. The fabrication of electronic devices for the manipulation and tuning of these states is desired. However, the mechanical exfoliation and isolation of atomically thin PtTe2 flakes is challenging, as it is for other transition metal dichalcogenides. Here, we present details on the sample fabrication of thin crystals of PtTe2, assessed through atomic force microscopy and encapsulated with hexagonal boron nitride (hBN), for future electronic transport measurements at low temperatures.

Funding for this research was provided by the Center for Emergent Materials: an NSF MRSEC under award number DMR-2011876 for sample fabrication, the Cal State Long Beach and Ohio State University Partnership for Education and Research in Hard and Soft Materials, a National Science Foundation PREM under Grant No. 2122199 for traveling.

88. An asteroseismic mass measurement for the mass gap object 2MASS J05215658+4359220

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2MASS J05215658+4359220 is a stellar binary system containing a red giant branch star and an unseen companion found within the Auriga constellation. Thompson et al. 2019 analyzed

this system, determining the red giant mass to be 3.2 with the companion object sitting at a mass of 3.3. This mass of the compact object situates it within the known ‘mass-gap’, a mass gap ranging from the lowest theoretical black hole mass and the highest observed mass for a neutron star. We re-examine the mass distribution for this system through the use of asteroseismology, providing a more precise mass constraint on the red giant as well as the unseen companion. Although oscillations are detected in the giant, we find that TESS data for the giant shows weak variability at ν_{max}, perhaps due to the giant’s rapid rotation. To corroborate the signal, we also derive an asteroseismic mass based on stellar variability at other frequencies. Both estimates confirm the mass of the compact object to be situated within a mass gap and are consistent with Thomspon et al. 2019. Forthcoming TESS data may enable a determination of the large frequency separation, which would further constrain the mass reported here, with implications for hierarchical merger populations and/or low-mass black hole formation.

This project is supported and funded by the Kristina T.L.Wong/L. Desmond Wong/Nancy F. Wong/Pamela T.M. Wong Rennick and Keung Lai Luke Assistantship.

89. Superconducting-Magnetic Proximity System In The Presence of an Applied Electromagnetic Field In The Clean Limit

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We present an update on the project that investigates the effect an applied time-dependent electromagnetic field on a proximity system made of superconducting and magnetic nanoscale thin films. The system is considered in the clean-limit, meaning that there are no impurities in the material.

To wit, we wrote a program that conducts a computational study of the Bogoliubov – de Gennes equations for a Josephson junction of various combinations of superconducting and magnetic materials. We assume a conventional singlet-pair superconductor in contact with a magnetic multilayer with a flexible magnetic configuration. The Hamiltonian includes the effect of the applied time-dependent electromagnetic field through the Peierls substitution of the hopping parameter, resulting in a differential equation in time for singlet and triplet pair correlations. We discuss how the equations are solved numerically using the Runge-Kutta method and what information can be extracted from its solution.

This research is supported by the National Science Foundation CSULB-OSU PREM program under project No. G2544211

90. Investigating the Role of Bolting-Induced Leaf Senescence Regulatory Genes in Response to Climate Change Stressors

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Leaf senescence (LS) is the final leaf development stage involving nutrient recycling and redistribution from older leaves to developing leaves and tissues. Chlorophyll (Chl) degradation is also induced, resulting in a progressing yellow phenotype that starts at the leaf tip in *Arabidopsis thaliana* (Arabidopsis; Zou et al., 2009). LS occurs naturally due to internal signals–bolting and aging–as well as external signals like biotic and abiotic stressors (Buchanan-Wollaston et al., 2002; Balazadeh et al., 2008). Bolting is the transition from a plant's vegetative to its reproductive phase. We determine a plant has bolted when the inflorescence stem is 0.5 to 1.0 cm. LS is associated with bolting in that early bolting leads to early LS and delayed bolting leads to delayed LS (Huang et al., 2019; Balazadeh et al., 2008). A bolting-induced gene regulatory network was predicted by Hinckley and Brusslan in 2020 showing genes *ERF054*, *HB34*, *bZIP34*, and *bZIP61* as regulatory hubs of bolting-induced LS (BILS). *bZIP34*, *bZIP61* and *HB34* and its redundant paralog, *HB23* were not previously associated with LS. During LS, reactive oxygen species, abscisic acid, and ethylene production increases (Huang et al., 2019; Gao et al., 2016; Li et al., 2013). Similarly, the same molecules play a role in response to climate change stressors such as soil salinity and drought (Peng et al., 2014; Lingqiang et al., 2000; Yoshida et al., 2002). We have isolated double mutant (DM) *bzip34bzip61* and *hb23hb34*, and single mutant (SM) e*rf054* Arabidopsis lines, and demonstrated that each mutant line delays LS. However, the role of the regulatory hubs in response to abiotic stressors is unknown. Currently, we are characterizing responses to soil salinity and drought stressors in Arabidopsis DM and *erf054* lines. For salt protocols, we are measuring Chl degradation and expression of *NIT2* and *SOS1*, markers of LS and salt-stress response, respectively. Similarly, for drought response, we are measuring leaf 3 weight and *NIT2* and *DREB2A* expression, a drought-stress marker. Preliminary results show a molecular hypersensitivity in *bzip34bzip61* and *hb23hb34* DMs and *erf054* SM in response to soil salinity. Additionally, *bzip34bzip61* displayed a more severe visible response to the salt treatments. Similarly, the drought treatment results demonstrate a delayed molecular response in all mutant lines compared to WT. Our data suggests LS and salt/drought-responsive pathways are independent but overlapping regulatory pathways.

91. Optical Conductivity in Twisted Bilayer Graphene

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Twisted Bilayer Graphene (TBLG) is a structure composed of two stacked graphene sheets with a relative twist angle between them. We study the optical conductivity as a function of the twist angle and other parameters of the model. In the first step we derive the expression for the optical conductivity. In the second step we numerically calculate the band structure of TBLG and the optical conductivity as a function of energy and momentum.

We acknowledge support from the NSF PREM program under grant 2122199.

92. The Regulation of Bolting-Induced Leaf Senescence by the ANAC046 Transcription Factor in *Arabidopsis thaliana*

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Leaf senescence is the natural aging process that recycles nutrients from older leaves to newly developing regions of the plant. Bolting is the transition from the vegetative to reproductive state of a plant. ANAC046 is a NAC-family transcription factor that is reported to be a positive regulator of leaf senescence in the model plant species, *Arabidopsis thaliana* and we want to test whether it plays a similar role in bolting-induced leaf senescence. We suggest that *ANAC046* loss-of-function mutant plants (*anac046* mutants) will show delayed bolting-induced leaf senescence, as measured by a delay in chlorophyll degradation and *NIT2* gene expression. These mutants carry a T-DNA insertion that disrupts the *ANAC046* gene. The Gene Regulatory Network (GRN), previously published by our lab, shows the genes that may be positively regulated by ANAC046: *AtATG18a*, *ATG8C*, and *MT1C*. Our hypothesis is these genes will show a smaller increase in gene expression in *anac046* mutants when compared to WT. Three experimental replicates were sown to compare WT and *anac046* through a timepoint analysis, where specific leaves were harvested at the time of bolting (T0) and 12 days after (T12). These plants were harvested for their leaf 3 to measure chlorophyll, which decreases during leaf senescence, and leaves 4 & 5 for *NIT2* gene expression, which increases during leaf senescence. For each trial, there were 10 WT T0, 10 WT T12, 10 *anac046* T0, and 10 *anac046* T12 samples. RNA was isolated from all three trials and used as a template for cDNA synthesis, which was then used to perform real-time qPCR to quantify *NIT2* mRNA levels, normalized to *ACT2*. In addition, the gene expression of the target genes was also quantified by real-time qPCR. In trial AD1, there is a significant difference between the chlorophyll of WT T0 and T12 as well as between WT T12 and *anac046* T12, showing that chlorophyll degradation was delayed in the mutant. Gene expression of *NIT2* showed a small but significant difference between T0 and T12 but

did not show reduced expression in the *anac046* mutants. The gene expression of *ATG8C* and *MT1C* displayed similar inductions of gene expression between WT and *anac046*, whereas *AtATG18a* showed a decrease in expression at T12 in *anac046*, opposite of that observed in WT. These initial data suggest ANAC046 upregulates *AtATG18a*. While there was no strong significant difference in *NIT2* gene expression, the findings for *AtATG18a* show support for the predicted GRN. Future trials are underway to strengthen these findings.

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93. Usadel Equations in a New Hyperbolic Function Parameterization

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We study the effect of electromagnetic radiation on pair correlations in Josephson junctions. These are sandwich-like nanostructures formed by two sides of superconductive material separated by a non-superconductive middle layer. In the presence of nonmagnetic impurities, this behavior is governed by the differential Usadel equations. To solve these equations, we propose a new parameterization using hyperbolic functions that avoids numerical issues seen in previous parameterizations. We also rewrite boundary conditions using this parameterization.

Our work was supported by the Office of Research and Economic Development (ORED) Summer Research Assistantship.

94. The Role of Tetraspanins and Extracellular Vesicles During Leaf Senescence

Luke Pickard, Kristen Fonseca, and Judy Brusslan Ph. D.

Previous studies in *Arabidopsis thaliana* have implicated tetraspanin (TET) proteins as important players for both leaf senescence (LS) and extracellular vesicles (EVs). TET8-associated EVs are one of two described EV populations in *Arabidopsis*. Additionally, Zimmerman et al. 2024 demonstrated that *TET3* and *TET8* are positive regulators of LS. This suggests other TETs may also be associated with EVs or with LS, and that EVs may play a role in LS. *TET7* and *TET18* were selected as the best candidates for this study. *TET7* was selected for its high expression during leaf senescence and close relation to *TET3* and *TET8*. *TET18* was selected for its expression during leaf senescence and presence in one EV proteome. EVs were isolated from WT plants via centrifuge and filtration and used for Nanoparticle Tracking Analysis (NTA) protocol development. EVs were detected using a Nanosight NS300, and tet8 signal was detected via western blot. *tet3*, *tet7*, *tet8*, and *tet18* plants were grown in soil for six weeks followed by LS phenotype analysis using chlorophyll concentration and

NIT2 expression analysis. *TETs* in similar roles are expected to show additive effects, with higher order mutants displaying a larger effect than single mutants. Triple knockout mutants, *tet3tet7tet8* and *tet3tet8tet18*, are being created for future experiments.

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95. The Electron Polarization and Plasmon Spectrum in Terms of Bloch Vectors

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We analyze how the collective motion of electrons in a metal (called plasmons) are affected by quantum geometric properties of the Hilbert space containing all solutions of the Schrödinger equation. For the most general crystal with *N* orbitals per unit cell, the Hamiltonian can be written in terms of *N* real Bloch vectors. These vectors allow for a visualization of the quantum geometric properties of the system. Expanding the electron polarization of the system in wavevector *q*, we write its explicit dependence on Bloch vectors and on the quantum geometric tensor. This will allow us to analyze how quantum geometry affects the plasmon spectrum.

We acknowledge support from the Google Student Summer Research Assistantship and the NSF PREM program under grant 2122199.

96. No abstract submitted

97. Python as a Tool to Analyze Photoemission Data

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Python, a versatile and highly customizable programming language, offers powerful capabilities for scientific applications involving data analysis, computation, and presentation. This study focuses on developing Python-based tools for analyzing Angle Resolved Photoemission Spectroscopy (ARPES) data, a crucial experimental technique in condensed matter physics that allows direct observation of electronic properties in materials. Our research specifically targets topological materials such as PdTe2, PtTe2, and Cr-alloyed PtTe2, which are of increasing interest in the field of quantum materials. While ARPES data analysis is typically performed using proprietary software like Igor Pro, our approach leverages Python's flexibility to create more adaptable and customizable analysis tools. These Python-based tools enable the extraction of energy and momentum distribution

curves from ARPES data, providing crucial insights into dispersion velocities and effective masses. Such quantitative analyses offer a deeper understanding of electronic properties that cannot be gleaned from conventional ARPES color-coded plots alone. Additionally, we explore advanced image processing techniques to further extract important electronic information from the studied materials. By utilizing these computational methods, we aim to uncover intricate details of material behavior that were previously inaccessible through standard visualization techniques, thereby enhancing our understanding of quantum materials.

98. Modeling Asteroseismic Yields of the *Roman Galactic Bulge Time-Domain Survey*

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The Nancy Grace Roman Space Telescope is anticipated to take infrared images of unprecedented quality and collect data to advance further our understanding of both the Milky Way and Galactic science. Roman will also provide asteroseismic data for the Galactic bulge, which will inform a wide range of fields in astrophysics. Of particular interest is the ongoing discussion regarding the possibility of a young stellar population in the bulge. Asteroseismic data promise to settle the debate by providing precise stellar ages, independent of existing photometric- and spectroscopic-based analyses. We describe expected yields for the upcoming Galactic Bulge Time-Domain Survey, making observations over the course of the nominal five-year mission plan. We investigate the effects on the resulting asteroseismic sample from assumed survey strategy, noise properties, and extinction models. By varying the fraction of the young-to-old bulge stars, we find that the asteroseismic yield is sensitive to the age distribution of the bulge, which confirms that even the asteroseismology yields themselves may place interesting constraints on the bulge age distribution. The resulting asteroseismic ages will also inform competing models of planet formation and evolution when combined with Roman's expected microlensing planet yields.

This research is supported under NASA Award 80NSSC24K0091

99. Synthesis of Flavor and Fragrance Compounds Using Photochemistry

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With the pressing need to find greener and more sustainable practices in chemistry, our project aims to optimize a known hydroacylation scheme that can be used as an educational tool in teaching labs. This reaction, which involves the photochemical synthesis of γ-butyrolactones introduces students to concepts in photochemistry, green chemistry and has a practical application to flavor and fragrance chemistry. It also presents opportunities to explore multi-step synthesis, stereochemistry, reaction mechanisms, and diastereotopic protons.

Specifically, *quercus lactone* and γ-nonalactone (whiskey- and cognac-lactone) can be synthesized via hydroacylation of a 3-methyl unsaturated ester with their respective aldehydes, in the presence of light. Subsequent reduction of the ketone and cyclization produce the γ-butyrolactones.

This approach requires no heat, making it energy efficient as well as demonstrating high atom economy, where ideally, all starting material atoms are present in the product. Applying both principles, we measured to what extent the reaction runs to completion. Our research investigates the scaling up from small-research scale experiments to larger quantities, aiming to optimize yield, and the practical feasibility for laboratory students. This initial study did not follow a stereospecific ketone reduction route, which revealed a mixture of diastereomers present with an overall odor that was mainly coconut with hints of earthy and celery-like notes. Future work for this project would highlight the use of an enzyme/baker's yeast to have stereo control to produce only one pair of diastereomers and adding to the green chemistry theme.

This project is made possible through the support of the Leslie K. Wynston Summer Research Assistantship Award as well as the donations made by Dr. Paul Buonora.

100. Fabrication and characterization of micropillar Josephson junction with Niobium Nitride and Permalloy/Samarium Cobalt exchange spring magnet

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Superconductors are prevalent in cutting-edge technology and research, such as MRI, quantum computers, and particle accelerators. The superconducting proximity effect

occurs when the superconductor is adjacent to non-superconducting material since the superconducting condensate, pairs of electrons known as Cooper pairs, leaks into a non-superconducting material. We fabricated micropillar Josephson junctions in hybrid superconductors and attempted to observe the odd triplet effect of superconductor (S)/ferromagnet (F)/superconductor (S/F/S) system. First Nb was used for S and a ferromagnetic exchange spring system of Permalloy (Py) and Samarium Cobalt (SmCo) were used for F. Due to the low superconducting critical temperature (T_c) of Nb we had a difficulty measuring the Josephson current in S/F/S junction. Therefore, in this work we introduce a new superconductor, NbN, which has much higher bulk T_c. We found T_c increased a lot from ~3.3 K for 100 nm Nb thin film to ~9.3 K for 100 nm NbN thin film. To optimize T_c of NbN thin film, N2 gas was introduced during the magnetron sputtering process. NbN thin films at different ratio of N2/Ar gas were made and T_c dependence on the ratio was investigated.

This project is supported mainly by the 2024 ORED Summer Student Research Assistantship. This work was also partially supported by the Partnership for Research and Education in Materials (PREM) program between California State University, Long Beach and The Ohio State through a grant from the National Science Foundation under Grant No. 2122199.

101. Chemical Biology Approaches to Modulating Cell States and Fates

Brooke Morales, Ariana Sulpizio, Jared T. Gillen Miller, Luke L. Lairson

Chemical biology allows scientists to create and apply chemical tools and approaches to answer key questions about biological functions. We looked at two chemical biology approaches that cause a cellular effect to advance the tools for two different conditions. We first developed a pathway biasing screen, that targeted the cGAS-STING pathway. T-cell infiltration is crucial for cancer prognosis, with CD8+ T-cell activation relying on type 1 IFN signaling. The cGAS-STING pathway, a dsDNA sensing signaling pathway, is a promising target for immuno-oncology due to its ability to activate type I IFN signaling. When dsDNA is misplaced in the cytoplasm, such as through cellular stress, cGAS senses and binds this dsDNA, triggering its catalytic activity and the production of 2'3'-cGAMP. cGAMP will then bind and activate STING causing its oligomerization and translocation from the endoplasmic reticulum to the Golgi apparatus. STING then recruits downstream signaling proteins to activate IRF3 and NFκB transcription factors. IRF3 activation results in the production of Type 1 IFNs, but at the same time, NFκB-dependent cytokines are released. This "cytokine storm" triggered by NFκB activation causes on-target toxicity, limiting STING agonists' therapeutic potential in the clinic. To address this, we developed a pathway biasing screen to find small molecules that work in conjunction with existing STING agonists to bias cGAS-STING towards the IRF3 arm of the pathway without affecting NFκB activation. Our screen identified three promising candidates from over 500 compounds. Secondly, we developed chemoproteomic tools to induce remyelination in multiple sclerosis patients. Oligodendrocytes (OLs) are a glial cell population responsible for remyelination in the

central nervous system and arise from oligodendrocyte progenitor cells (OPCs). In demyelinating disorders such as multiple sclerosis, OPC differentiation is impaired but can be stimulated with specific molecules. A high-throughput screening identified an imidazopyridine-based molecule that promotes OPC differentiation. Follow-up studies revealed key modification sites on this molecule. From this, we synthesized a diazirine-alkyne probe for proteome labeling in Ols and tested its activity in a competition-based rhodamine labeling experiment. Competition was found, showing the activity of the compound. Further testing will be run to continue to validate the activity of the probe. To show the biomolecular target, MS-based quantitative proteomics will be performed.

102. No assigned abstract

103. The Zak Phase and Topological Phase Transitions in One- and Two-Dimensional Models

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The Zak phase is an open-path, gauge invariant integral over the first Brillouin Zone, whose ends are connected by a reciprocal lattice vector. If the Zak phase changes value when varying parameters of a model, then the system has undergone a topological phase transition. The transition can be expressed as the closing and reopening of the band energy gap upon variation of the parameters. In one-dimensional systems we calculate the Zak phase of multiorbital systems as a function of the location of the orbitals in the unit cell. Specifically, following work by Fuchs and Piéchon we study the one-dimensional Shockley and Su-Schrieffer-Heeger models and discuss how the first (second) model undergoes (does not undergo) a topological phase transition. In two dimensions, we start with the 3-band model of the CuO_2 plane in a high-temperature superconductor and modify parameters along the two directions of space. We discuss the Zak phase over the Fermi surface, which in this case is a one-dimensional path. Changing orbital hopping and onsite energies we only find the closing and reopening of the band gap when the local energies for the p and d-orbitals are equal.

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104. Understanding and Navigating Abnormal Mammogram Results in Latin/x Patients

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At AltaMed, focus groups were conducted of Spanish-speaking Latina patients and community members who had received abnormal mammogram results or a breast cancer diagnosis to understand their experiences during Spring 2024. This allowed our team to

explore factors affecting their progress in seeking further care, and identify areas for improvement. The analysis revealed a strong need for better education on wellness, support groups, understanding medical terminology, navigating the healthcare system, and enhancing health literacy. This project aims to develop a brochure tailored to the needs of Latina women, providing essential information following an abnormal mammogram or breast cancer diagnosis. The brochure will serve as a comprehensive resource for patients, guiding them through their diagnosis, follow-up steps, and wellness maintenance, while also directing them to emotional support resources. A literature review and thematic analysis of focus group data was conducted to gather relevant insights. The project team, comprising PCLP and AltaMed scholars, physician mentors, and women's health professionals, collaborated to ensure the brochure effectively addresses patient concerns. The brochure includes information on diagnosis, follow-up care, wellness, and emotional support, presented in accessible language tailored to Latina women. It aims to improve the patient experience, helping them navigate the next steps with clarity and confidence. Future steps for the brochure will be to refine it by engaging with community members and patients in focus groups to offer feedback. Then we would disburse through AltaMed and obtain further feedback from physicians and patients.

This project is supported by National Medical Fellowships, Inc. (NMF) and Community Organizing and Research Engagement (CORE).

105. Optimization of Agarose Gel Electrophoresis for High Resolution of Genomic DNA separation

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DNA damage is a natural consequence of daily life. Various factors, originating from both environmental stresses and endogenous metabolism, pose a continuous threat to the integrity and functionality of the human DNA within the genome. If it left unrepaired can produce mutations, chromosomal aberrations, and induce cell death. Detection, characterization, and quantification of these genomic modifications and strand breaks provides important information about genotoxic exposures and cellular responses. These data are critical for health risk assessment, especially to monitor the effectiveness of chemo-preventives, or the efficacy of chemotherapies. There are several current techniques for detecting DNA damage and others for evaluating the underlying repair mechanisms. The limitations for those techniques need deliciated well-trained personal and high cost of instrumentations. The goal for this project is to develop the novel 3D-printed device to do pre-scanning and determination of chromosome DNA damages in low-cost and fast ways.

Agarose gel electrophoresis (AGE) is a common molecular biology technique that utilizes an electric field to separate macromolecules by size, such as nuclear acids or proteins. To get the better resolution of AGE, it is critical to optimize the existing AGE running conditions. We examined the effects of voltage, percentages of agarose gel, staining conditions and destaining periods, as well as the concentration of chromosome DNA. As expected, increasing voltage subsequently increased electrical current, buffer temperature, and migration rates. A lower agarose gel percentage resulted in a higher resolution with genomic DNA samples, though a significantly more brittle gel. The DNA concentration of running samples directly corresponds to the intensity and size of the DNA bands. Loading samples of low DNA concentration require smaller amounts of sample, though increase the degree of uncertainty and risk of unquantifiable bands. Current AGE data we collected will be used to solidify the standard measurements and conversions for future projects in DNA damage detection.

This project was supported by the UROP/BUILD program, CSULB Mini-Grants and Summer Stipends (MGSS) Grant and KURE Incubator.

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106. Neutron Star Properties using the Zhao-Lattimer Equation of State

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Constraining the properties of neutron stars is a key element in specifying the equation of state that describes the state of matter within the interior of the star. By comparing observational data obtained from experiments such as the Laser Interferometer Gravitational-Wave Observatory (LIGO) with the properties predicted by the equation of state, limitations can be set on the equation of state. The Zhao-Lattimer equation of state (ZL EoS) is a relatively recent and flexible formulation of dense nuclear matter that meets several observational constraints on neutron stars. We use a numerical solver for the Tolman-Oppenheimer-Volkoff equations to determine the mass and radius of the star given energy density and pressure data obtained from the ZL EoS. In future, we will vary the parameters within a range to determine their impact on sound speeds and oscillation modes.

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107. Detection of Bisphenol A leaching in packaged drinking water and beverages using colorimetric detection

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Bisphenol A (BPA) is an organic compound commonly used in plastic of consumer products. Exposure to BPA occurs daily from food packages, water bottles, thermal receipts, grocery bags, dental sealants, household electronics, and more. BPA has many detrimental effects on human health, such as acting as an endocrine-disrupting chemical. It can induce the expression of estrogen, DNA damage, increase the risk of insulin resistance, and interfere with cancer-related pathways. Because of its detrimental effects on human health, detection of BPA in water is an area of interest. By harnessing the power of color changes induced by BPA's interaction with a specific colorimetric reagent, this method ensures a quick and reliable assessment of BPA levels. The tests conducted cover a variety of popular packaged drinks, revealing the capability of the method to detect even trace amounts of BPA – levels well below what might be considered safe. Not only is this colorimetric method effective, but it also stands out for its simplicity and affordability when compared to traditional detection techniques. It offers a non-intrusive way to check if your go-to drinks are BPA-free, contributing to greater transparency and peace of mind for consumers. In summary, this study introduces an uncomplicated and efficient colorimetric method to detect Bisphenol A in packaged drinking water and beverages. It's a step towards ensuring the safety of the products we love, empowering consumers with information about what's really in their favorite drinks.

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108. No assigned abstract

109. Keck Undergraduate Research Experiences (KURE) Incubator: environmental toxins are sneaking into your life

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The KURE Incubator project launched a research bridge program in summer 2024 that was designed for any undergraduate/high school students who are interested in Science, Technology, Engineering and Mathematics (STEM) but have not yet had an opportunity to participate in research. This program provides an overview of environmental toxicology,

including an examination of the major classes of pollutants, their fate in the environment, their disposition in organisms, and their mechanisms of toxicity. An emphasis of the program are the principles and methods of biological testing for toxicity and health effects, risk assessment, and the impact of pollutants on daily life items and ecosystems. Bisphenol A (BPA) and triclosan (TCS) were chosen toxins of interest, because they are pervasive environmental toxins with human impacts that raise concerns. BPA, commonly found in plastics, epoxy resins, and thermal paper, leaches into food and water, exposing humans through ingestion and skin contact. Triclosan, an antimicrobial agent, is common in personal care products like soaps, toothpaste, and cosmetics, along with household items like plastics and textiles. Both chemicals disrupt endocrine function by mimicking or blocking hormones. Endocrine disruption can lead to developmental abnormalities, reproductive issues, and increased risk of certain cancers. Throughout this program with the goal of not only introducing the early authentic research experiences but also educating students about overlooked dangers in household items and how we use those items safely".

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110. No assigned abstract

111. Quantum Topological Phases Arising from the Weyl-Kondo Semimetal model

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In this study, we investigated the topological and quantum phases emerging in a strongly correlated electron system, using the Weyl-Kondo semimetal model, a nontrivial version of the periodic Anderson model of heavy fermion systems [1,2]. We implemented a self-consistent computational approach to solve the saddle-point equations and explored the parameter space of the Weyl-Kondo semimetal model. Our numerical results calculate the order parameters of the heavy Landau Fermi liquid phase, which provide insight into the stability of the novel quantum states in response to varying model parameters. In particular, we examined how the transition from a topological semimetal state versus to a trivial insulator state affects the Kondo coupling interactions between localized f-orbital electrons and conduction electrons. Using our computational framework, we also simulated the varying of spin-orbit coupling and other microscopic parameters on a noncentrosymmetric lattice to model the chemical substitution series $Ce_3Bi_4(Pt_{(1-x)}Pd_x)_3$ ($0 \leq x \leq 1$) performed in recent experimental studies [3,4]. By varying the spin-orbit coupling, we observe a topological phase transition between Kondo insulator and Weyl-Kondo semimetal states and analyze the critical spin-orbit coupling point. By connecting our computational findings with experimental observations, we provided a theoretical foundation for understanding the emergence of topological metals in strongly correlated systems. Our work highlights the

importance of the interplay between multiple degrees of freedom, including charge, spin, and orbital interactions, in shaping these exotic quantum phases.

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