November 7, 2025

Abstract Book

Postdoctoral Services

Research Talks Session I – 12:15 - 1:15 p.m. ET

01. Signs of learning: What brain waves and gaze reveal

Oindrila Sinha*, **Lewis Wheaton**

Imagine learning a new piano riff or a tennis serve. Early on, every move is slow and effortful: shoulders tight, eyes jumping ahead, timing fractured. With practice, the stutters knit into a single, fluid sequence. Crucially, that shift from effortful to automatic isn't uniform: people progress in different orders and at different speeds, with plateaus and sudden jumps that group averages hide. If we could locate a person's position on that learning curve in real time, before they can even explain it, we could deliver the right practice at the right moment, tightening rehabilitation, accelerating skill in sport, and improving any domain that relies on sequential action. To test this idea, we designed a synchronized reach-and-place sequence task instrumented with kinematics, eye tracking, and EEG, capturing trial-by-trial brain–behavior dynamics as participants practiced an embedded repeated sequence. We examined how event-related potentials (ERPs) and gaze behavior changed with learning. ERPs are tiny, time-locked electrical responses in the brain when a cue appears, or a movement happens. We also asked whether gaze fixations stabilized on task-relevant elements and began to anticipate the next item in the repeating sequence. This multimodal view revealed a compact two-feature signature: earlier, stronger task-locked ERP responses paired with rising anticipatory gaze reliably indexed the shift from effortful execution to fluent sequencing at the individual level. Practice was accompanied by clear brainwave changes and a behavioral shift toward more predictive fixations. Together, these features staged learners along an continuum and flagged transient "step-ups" that group averages miss. In practice, this yields actionable biomarkers that reveal when a person is ready to progress, offering a precision-timed lever for rehabilitation, coaching, and adaptive training systems. By staging learning in, real time independent of self-report: therapists, trainers, and devices can deliver the right challenge at the right moment.

02. How microstructure controls air dissolution and water saturation in emerging cementitious materials: Insights for freeze-thaw durability

Aiqing Xu *, **Kimberly E. Kurtis**

Cementitious materials in cold regions often suffer from freeze-thaw damage. When water enters internal pores, it freezes, expands, and eventually causes cracking. The resistance of cement-based materials to freeze-thaw damage depends on how entrained air dissolves and how water gradually fills the pore network. Understanding these processes is important for improving durability and developing more sustainable construction materials. This study applies a physics-based model to describe the dissolution of entrained air and the saturation of water within the pore structure. The model, originally developed for ordinary Portland cement (OPC), is extended here to other emerging cementitious systems, including calcium sulfoaluminate (CSA) cement, limestone calcined clay cement (LC3), and geopolymers. Material-specific features related to microstructural transport are incorporated to capture differences among systems. The results demonstrate that microstructural characteristics strongly influence both the rate of air dissolution and the long-term saturation behavior. Dense systems, such as LC3, retain air for longer periods and slow the approach to harmful saturation levels, enhancing freeze-thaw resistance. By contrast, more loose and coarse systems such as OPC allow faster dissolution and earlier critical saturation, making them more vulnerable. These findings highlight the key role of microstructure in controlling moisture and air transport. They provide a clearer basis for understanding freeze-thaw deterioration and support the design of cementitious materials that are more durable, resilient, and sustainable in service..

03. When chemotherapy misfires: Motoneuron hyperactivity in oxaliplatin treatment

Kathy Bui*, **Nardelli, P.; Housley, S.N.; Cope, T.C.**

Abstract cannot be shared publicly.

04. Credit-based vs. discount-based congestion pricing: A comparison study

Chih-Yuan Chiu*, **Devansh Jalota, Marco Pavone**

Congestion pricing has emerged as a promising policy to mitigate traffic congestion, but also faces criticism for placing excessive financial burdens on low-income commuters. To offset the negative financial impact of road tolls on less affluent users, the state of California launched credit-based congestion pricing (CBCP) and discount-based congestion pricing (DBCP) pilot programs, which respectively allot travel credits and toll discounts to subsidize low-income communities' access to tolled freeway lanes. However, since the deployment of CBCP and DBCP policies in real-world traffic is nascent, the relative merits and disadvantages of each policy remain unclear. In this collaborative work with Drs. Devansh Jalota and Marco Pavone, we compare the efficacy of deploying CBCP and DBCP policies to reduce traffic congestion and collect toll revenue for reinvestment and redistribution. We formulate a congestion pricing policy in which a subset of users receive a travel budget or toll discount for toll lane entry, while other users must pay out-of-pocket to access tolled lanes. We establish that Nash equilibrium (steady-state) flows corresponding to our policy formulation always exist, and can be computed or well approximated via a convex program. We then formulate societal cost metrics which encode travel cost minimization and toll revenue maximization. As our main contribution, we present conditions on the traffic network structure and user population under which DBCP policies provably outperform CBCP policies in minimizing a given societal cost at equilibrium. Conversely, we provide examples in which CBCP policies outperform DBCP policies when the aforementioned conditions are violated. We validate our theoretical contributions on a case study of the 101 Express Lanes Project, a CBCP program implemented in California. Our numerical results confirm the advantage of deploying DBCP rather than CBCP policies to alleviate traffic congestion and collect toll revenues, while providing low-income users with reliably efficient travel options.

05. Light-field flow cytometry: Multiparametric single-cell analysis with high-throughput, high-resolution 3D imaging

Xuanwen Hua*, **Keyi Han, Shu Jia**

Flow cytometry and fluorescence microscopy are two vital techniques in biomedical research, enabling rapid analysis of cellular populations and high-resolution imaging of individual cells, respectively. Imaging flow cytometry (IFC) integrates these strengths, offering high-throughput, multiparametric single-cell analysis with spatiotemporal sensitivity and molecular specificity. However, current 2D IFC ignores 3D information, while 3D IFC approaches often face trade-offs between resolution, volumetric coverage, and throughput, as well as increased instrumental complexity. On the other hand, light-field microscopy (LFM) provides an attractive strategy to overcome these limitations by recording spatial-angular information of the light field in a single snapshot, followed by computational 3D image reconstructions. Recent advances in Fourier LFM have further improved image quality and computational efficiency, suggesting great potential for cytometric imaging. Building upon these principles, we develop a light-field flow cytometer (LFC), a 3D IFC system designed for high-throughput, high-resolution, multiparametric volumetric imaging of subcellular morphology, dynamics, and interactions. The system is constructed on a high-resolution light-field optofluidic platform with hydrodynamic focusing and stroboscopic illumination. It achieves throughputs exceeding 5,000 cells per second, near-diffraction-limited resolution, and multicolor capability, thereby overcoming the long-standing trade-off between throughput and 3D resolution in IFC. We demonstrate broad applicability of LFC by interrogating diverse biological and functional contexts, including 3D imaging of peroxisomes and mitochondria in cultured cells, heterogeneity investigation of mouse and human cells, apoptotic alterations in staurosporine-treated Jurkat cells, and gene expression following Cre mRNA delivery in cells from different mouse organs. These results highlight the ability of LFC to quantify structural, functional, and heterogeneous properties of cells at unprecedented throughput and resolution. Importantly, the LFC maintains low instrumental complexity and compatibility with standard epi-fluorescence microscopes and microfluidic devices, making it broadly accessible. This advance establishes LFC as a transformative cytometric imaging platform with wide impact in biology, pharmacology, and medical diagnostics.

Lightning Talks Session I – 2:20 - 3:00 p.m. ET

06. Smarter supplier networks through data and manufacturing capabilities

Suyoung Park *, **Shreyes Melkote**

Manufacturing supplier networks are facing increasing challenges from disruptions, demand fluctuations, and the need for rapid adaptation. Traditional supplier selection methods often depend on historical records or manual assessments, which are slow and inconsistent. These limitations prevent companies, especially small and medium-sized enterprises, from building flexible and resilient supplier networks that can adjust to fast-changing environments. Strengthening the ability to match products with the right suppliers in a timely and reliable manner has therefore become an essential requirement for modern manufacturing systems.This research introduces a data-driven framework to construct supplier networks that are explicitly aware of manufacturing capability. The approach uses digital product data, including three-dimensional models of components and assemblies, combined with practical manufacturing metrics such as cost, time, and tolerance. From this information, the system generates compact numerical representations that capture both product features and production requirements. By comparing these representations across suppliers, the framework automatically identifies which suppliers are capable of manufacturing a given part or assembly.Unlike traditional methods, this approach integrates multiple layers of information: product geometry, assembly relationships, and production attributes. The result is a supplier network that not only improves matching accuracy but also provides ranked recommendations based on manufacturability. Preliminary studies demonstrate that representation-based supplier networks can significantly reduce decision time while maintaining high reliability, offering a systematic alternative to subjective or experience-based decision making.The broader significance of this work lies in enabling adaptive and resilient supplier networks. By leveraging data-driven intelligence, manufacturers can quickly reconfigure sourcing strategies when disruptions occur, explore alternative suppliers with confidence, and shorten product development cycles. In the long term, this framework has the potential to accelerate innovation, reduce risks in global supply chains, and support the strategic growth of a more competitive and sustainable manufacturing ecosystem.

07. The anti-social family: From continuous to contiguous attachments

***Anwita Ghosh **

The nineteenth-century Victorian novel often reinforced the authority of the nuclear family, presenting marriage, inheritance, and reproduction as natural foundations of social order. By the early twentieth century, however, modernist writers confronted upheavals (imperial decline, shifting gender roles, racial anxieties, and economic change) that destabilized this model. As Melinda Cooper notes in Family Values, “The history of the family is one of perpetual crisis.” Yet despite repeated predictions of its demise, “to attack the family is as unthinkable in liberal-democratic politics as it has ever been.” My talk takes up this paradox: how modernist literature both registered the crisis of the family and dared to imagine its alternatives.To address this problem, I combine archival research, close textual analysis, and theoretical frameworks from kinship studies and psychoanalysis. I distinguish between continuous affiliations—grounded in inheritance, similarity, and reproductive futurity—and contiguous affiliations, which form through adjacency, improvisation, and care across difference. Reading certain novels by E. M. Forster, Rabindranath Tagore, Jean Rhys, and Nella Larsen, I situate literary form (plot, narration, and character relations) against the historical pressures of empire, race, and sexual politics.My findings show that modernist fiction repeatedly displaces the expectation of the stable nuclear family and offers alternative modes of belonging. Forster imagines inheritance outside patriarchal lineage; Tagore portrays women who resist the sanctity of marriage; Rhys and Larsen create heroines who unsettle maternal and racial scripts. Across these examples, kinship emerges not as fixed by blood or law but as contingent, chosen, and fragile. Ultimately, my research demonstrates that modernist writers were not merely critiquing the family but reimagining its social function. By recovering these “anti-social families,” I argue that modernist fiction reveals the family as open to reinvention, an insight that remains urgent today, when the nuclear family is both politically untouchable and socially fragile.

08. Disentangling host, pathogen, and interaction effects on infection-induced mortality

Canan Karakoç*, **Sam Brown**

Background: Despite the profound impact of infectious diseases on global mortality, the fundamental drivers of infection-induced death remain unclear. The relationship between within-host processes—pathogen replication, immune response, and tissue damage—and epidemiological patterns of mortality has been difficult to resolve. Using a structured literature review, mathematical modeling, and experimental data, we investigate whether infection-induced mortality follows a constant, accelerating, or variable trajectory and explore the mechanistic basis of this pattern.

Methods & Results: Across diverse experimental infection models, we find that the risk of death increases approximately exponentially in time since infection, mirroring all-cause mortality dynamics. However, this accelerating risk is consistent with multiple within-host mechanisms, including pathogen growth and host-mediated damage. Mathematical models show that survival data alone cannot distinguish between these mechanisms. To address this, we developed a *Galleria mellonella–Pseudomonas aeruginosa* infection model to track pathogen density and mortality in parallel cohorts. Pathogen burden increased logistically, while instantaneous mortality increased exponentially, suggesting a coupled dynamic between pathogen replication and host deterioration. Extending this framework, we analyze survival dynamics across a broad range of host-pathogen systems, testing for evolutionary and ecological constraints on infection outcomes. We identify variation in survival trajectories that is not strictly explained by host or pathogen taxonomy, suggesting a dominant role for interaction effects. Using phylogenetic comparative methods and statistical modeling, we quantify the contributions of host traits, pathogen traits, and environmental conditions to infection-induced mortality.

Conclusions: Our findings challenge simplistic assumptions about host-pathogen interactions and highlight the need for improved experimental approaches integrating pathogen burden and host health over the course of infection. By bridging within-host processes and epidemiological patterns, we provide a framework for disentangling the drivers of infection-induced mortality, with implications for disease modeling, experimental design, and pathogen evolution.

09. Personalized exoskeleton control for optimizing gait economy post-stroke

Daniel Rodriguez-Jorge*, **Gregory Sawicki, Aaron Young**

Stroke survivors often face impaired gait and reduced walking efficiency, limiting mobility and quality of life. Wearable exoskeletons can improve ambulation, but current systems lack adaptability and real-world applicability. This study introduces a personalized exoskeleton control system using neural networks and Bayesian optimization to reduce metabolic cost and enhance gait mechanics. The system employs temporal convolutional neural networks (TCNs) trained on data from 19 stroke survivors to estimate lower-limb joint torque and power (hip, knee, ankle). These predictions feed into a Bayesian optimizer that adjusts torque profile parameters—scale, delay, and shape—to minimize positive biological joint work. Unlike prior device-specific approaches, this method uses device-agnostic data, enabling broader applicability and adaptability across different exoskeletons. Results show strong predictive performance: torque estimation RMSE ≈ 0.15 Nm/kg and power estimation RMSE of 0.19, 0.17, and 0.23 W/kg for hip, knee, and ankle, respectively. Offline optimization consistently favored high scale, low shape, and delays of 120–180 ms, aligning with previous findings. These optimizations are expected to reduce metabolic cost during walking, though real-time human-in-the-loop tuning may refine parameters further. This work demonstrates the potential of combining AI-driven control with Bayesian optimization to create adaptive, personalized exoskeleton systems for stroke survivors. Our current efforts focus on real-world testing of hip and ankle exoskeletons to validate improvements in community ambulation and long-term usability.

10. Source classification of black hole and neutron star binaries with gravitational waves

Caitlin Rose *, **A. Ray, V. Valsan, P. R. Brady, D. M. Wysocki, Y. K. Chu, J. D. E. Creighton, C. Hoy, Y. Peng, S. Sachdev, S. Morisaki, R. O'Shaughnessy, A. B. Yelikar, A. R. Hardison, M. Dehghan, C. Messick, and B. Piotrzkowski**

In 2017, the founders of LIGO (Laser Interferometer Gravitational-wave Observatory) won the Nobel Prize in Physics for the first detection of gravitational waves, predicted by Einstein's theory of general relativity. Since then, the LVK (LIGO-Virgo-KAGRA) collaboration has amassed a catalog of 218 observations of these ripples in the fabric of spacetime from the collisions between black holes and neutron stars. Among the most significant of these events is a binary neutron star coalescence, which was the first multi-messenger observation with both gravitational waves and electromagnetic radiation. The focus of my work is in the facilitation of these coincident detections by quickly classifying the sources of gravitational waves for astronomers on behalf of the LVK collaboration. We use Bayesian parameter estimation of the component masses of a binary to estimate the probabilities that the gravitational-wave candidate originates from a binary black hole, binary neutron star, or neutron star-black hole system. This method also has the capability to estimate the probability that a gravitational-wave candidate has a theorized sub-solar mass object such as primordial black holes, a possible source of dark matter. Timely communication of source classification probabilities helps astronomers make informed decisions about which events they should try to observe in electromagnetic follow-up campaigns. This new age of multi-messenger astrophysics will be crucial in solving mysteries about our universe, such as its rate of expansion.
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11. Do test biaes really matter? A practical framework for fairness in large-scale assessments

Yichi Zhang *

Abstract cannot be shared publicly.

12. Beyond small deformations: Advancing time-domain aerodynamics for flexible structures

Luisa Piccolo Serafim* **, Earl Dowell**

Abstract cannot be shared publicly.

Research Talks Session II: 3:00 – 4:00 p.m. ET

13. A unified framework for executing and evaluating models of the human visual cortex

Ruolin Wang*.

Abstract cannot be shared publicly.

14. From index properties to failure at depth: A physics-informed machine learning approach

Gyeol Han*, **H. Huang, J.C. Santamaria.**

Geothermal energy offers a uniquely stable and universal power source, surpassing the geographic and temporal limits of wind and solar. Realizing its full potential demands drilling into superhot rock reservoirs, a strategy promising a tenfold increase in power output over conventional wells. However, these depths present a critical challenge: rocks transition from stable-brittle to unstable-ductile. Predicting this operational "sweet spot" is essential, yet current methods fail. Field sensors cannot survive the extreme conditions, retrieved core samples are irreversibly altered, and existing laboratory data is sparse and inconsistent.We solved this challenge by building a predictive model from the largest known database of high-P/T rock experiments. Our hybrid framework sets a physics-based guardrail to define impossible boundaries and uses a machine learning compass to discover probable terrain, overcoming the traditional impasse between interpretable physical models and accurate "black-box" algorithms. The model accurately predicts rock strength and stiffness within a tight ±11–14% error range using only field-measurable inputs. Crucially, it reveals the brittle-ductile transition is a shifting surface, not a fixed line. This insight resolves long-standing experimental paradoxes, explaining why rocks with similar properties often exhibit vastly different behaviors. This framework also guides future data acquisition by identifying which measurements are most critical for model accuracy. Ultimately, our work offers the first quantitative roadmap for Brittle-Ductile Engineering—a new paradigm for actively controlling a rock's state. This approach will stimulate geothermal reservoirs safely and efficiently, accelerating the deployment of this critical global energy source.

15. Deep learning predicts protein motion and exposes hidden drug pockets for inflammatory disease

***Katie M. Kuo**, Andrew Pang, Ngoc Phuong Dung Ho, JC Gumbart**

Proteins are not static entities; they are constantly in motion. These dynamics create hidden pockets where drugs can latch on. Most approaches for drug discovery only consider a single snapshot of a protein, which misses these hidden pockets. We built DeepPath, a deep-learning method that takes protein snapshots and generates dynamics, then validates it with basic physics to ensure the motions are plausible. We tested DeepPath on TNF-a (tumor necrosis factor-a), a signaling protein that drives harmful inflammation in diseases like psoriasis and rheumatoid arthritis. The protein dynamics showed where potential drugs could bind: a previously found site that takes different shapes in the DeepPath output. Next, we screened candidate drugs computationally to see which bind to these sites. When we screened against the results from DeepPath, we found ten times the number of potential drugs than when we screened against the typical, single snapshot (the experimental structure of TNF-a). The larger set gives us more diverse and improved starting points for new medicines. This demonstrates that by predicting the motion of proteins, we can uncover potential drugs that static approaches overlook. More broadly, DeepPath can speed up the discovery and development of safer, more effective treatments for a wide range of diseases.

16. How faculty incorporate health disparities in biomedical engineering education

Julia M. Brisbane*

Health disparities—preventable differences in health outcomes between groups of people—have profound consequences for health and well-being. Because biomedical engineers design engineering solutions that directly impact human health, it is essential that they recognize and address these disparities. For example, pulse oximeters, devices that measures blood oxygen levels, perform less accurately on individuals with darker skin tones, potentially exacerbating disparities. Consequently, biomedical engineering (BME) faculty across the nation have begun integrating these topics into their undergraduate courses. Yet, most engineering education research focuses on isolated courses rather than the full curriculum, and many faculty lack the time or resources to share their approaches. A comprehensive examination across multiple courses is needed to understand how undergraduate BME programs prepare students to engage with health disparities. The purpose of this exploratory study is to investigate how faculty integrate health disparity topics into undergraduate BME courses. The study draws on qualitative course materials from 19 courses, as well as 11 faculty interviews conducted across nine U.S. institutions. Using thematic and content analysis, I identified common instructional practices as well as opportunities to enhance curricula. Findings indicate that health disparities are most often introduced through case studies, journal article readings, and group projects, typically focusing on race, gender, and well-known ethical cases such as the Tuskegee Syphilis Study and Henrietta Lacks. Far fewer courses addressed social determinants of health, the role of diverse teams in creating engineering solutions, or disparities beyond those affecting women and people of Color. Strengthening the integration of health disparities into undergraduate BME education can equip graduates to not only have innovative ideas but also to develop solutions that address health outcomes for all people. By broadening and deepening this content, programs can prepare future biomedical engineers to make meaningful, equitable contributions to healthcare and society.

17. Lowland biotic attrition, and the escalator to extinction in a tropical bird community: A 37-year re-survey

Samuel E.I. Jones*, **Benjamin G. Freeman**

Recent studies have documented declines in the diversity of tropical lowland bird communities attributed to the insidious impacts of warming climates in the absence of habitat change. “Lowland biotic attrition” is one explanation for these trends – that tropical lowland species shift up in elevation to track their climatic niches into the cooler foothills of mountains, subsequently leading to the gradual loss of species diversity from the lowlands. Leveraging data from an extensive 37 year ‘re-survey’ along a continually forested sea-level to mountain top gradient in Costa Rica, we test the predictions of “Lowland biotic attrition”. We document significant declines in both the abundance and richness of species in the tropical lowlands, but find limited evidence for redistribution of lowland communities into the foothills. While some species have shifted their distributions away from the lowlands consistent with the attrition hypothesis, we find a general pattern of lower elevation communities impacted greater than those at higher elevations. Taken together, we highlight potential mechanisms of avian community change in the worlds most biodiverse regions, as well as showcase the importance of rigorous quantitative baseline data to tackle fundamental ecological hypotheses.

Lightning Talks Session II: 4:15 – 4:55 p.m. ET

18. Using nature's blueprints to develop new drugs: Discovery of a unique enzyme from ocean microbes

***Nirmal Saha**, F. N. U. Vidya, Youran Luo, Wilfred A. van der Donk, Vinayak Agarwal**

Nature constantly invents remarkable chemical tools, and our research uncovers one such tool – an enzyme from marine microbes that performs unique chemical reactions, which scientists can harness to develop new medicines. In this study, we identified a special enzyme called a halogenase in marine microbes that adds bromine atoms to specific parts of ring-shaped peptides known as macrocyclic lanthipeptides. These peptides are promising drug candidates because their ring structure makes them more stable and better at interacting with biological targets. Our approach used genome mining, which involves searching microbial genetic data, to find this enzyme that selectively modifies the indole group of the peptide. This bromine addition creates a chemical handle that allows further molecule modification through mild, water-based chemical reactions. These modifications enable the creation of various new peptide structures with potential therapeutic uses. We examined how the enzyme recognizes the peptide and found that it prefers the ring-shaped form and requires interaction with a helper segment called the leader peptide for activity. This insight is vital for understanding how to use the enzyme effectively. By combining genetic discovery with chemical engineering, our work opens new possibilities for designing custom peptides and expanding tools for drug development. Such enzymatic modifications provide a precise and environmentally friendly way to enhance complex molecules, advancing the future of peptide-based medicines and biotechnological applications.

19. A durable water disinfection system using electric fields and copper ionization with a regenerating stainless-steel/copper electrode

Wei Wang*, **Xing Xie**

Drinking water disinfection is critical for ensuring public health. The current standard water disinfection techniques, including chlorination, ultraviolet irradiation, and ozonation, are widely used but often produce harmful disinfection by products (DBPs). To address this challenge, a promising alternative combines copper (Cu) ion release with an applied electric field to inactivate microorganisms. This method requires only small amounts of Cu and low energy input and can minimize DBP formation. However, current systems typically use thin copper wires as electrodes, which degrade quickly and result in poor copper utilization efficiency. These limitations lead to frequent shutdowns for maintenance and reduce the practicality of long-term operation. In this study, we introduce a new electrode design (Stainless-Steel/Copper) that uses a stainless-steel core with a copper coating. The stainless-steel core provides mechanical and electrochemical durability and prevents electrode failure, while the copper shell supplies the disinfecting ions. This structure enables near-complete Cu release (~100%) and significantly improves material efficiency. More importantly, the Cu layer can be regenerated in situ within the device through a simple electrodeposition process, avoiding the need for frequent system shutdown and electrode replacement. The system operates in cycles of ~25 h with only about half an hour required for electrode regeneration. These findings highlight the potential of the new design as a practical, long-term solution for reliable water disinfection.

20. Coupled thermo-chemo-mechanical modeling of reactive solids for thermochemical energy storage applications

Srivatsa Bhat Kaudur*, **Claudio Di Leo**

Abstract cannot be shared publicly.

21. Hunting for painkillers in the sea: marine natural products that target nerves

Adetola H. Adewole*, **Bhuwan Khatri Chhetri, Ghada M. Abdelwahab, Riya Bhanushali, Anne Marie Sweeney-Jones, Madison Greene, Jaehoon Shim, Carter K. Asef, Patric Vaelli, Lee Barrett, Facundo M. Fernandez, Cassandra L. Quave, and Julia Kubanek**

Voltage-gated ion channels play a critical role in the generation and propagation of electrical signals. The blockage or loss of function of the voltage-gated sodium channel $Na_v1.7$ results in analgesia, making it an attractive target for pain relief. Marine organisms are sources of structurally diverse secondary metabolites with promising pharmacological activities. Despite their potential, they remain underexplored as sources of new treatments for pain. In our efforts to identify bioactive natural products, we screened our marine natural product extract library, which comprises over 7000 fractions obtained from more than 2000 marine algae and invertebrates. Using a high-throughput fluorescence-based thallium flux assay, we recorded a 2.5% hit rate, comprising extract fractions with significant potency. These hits consisted of mixtures of mid-polarity metabolites from red algae, sponges, and corals. A notable hit came from *Halymenia* sp., an ecologically significant but chemically understudied red alga found in the tropical Pacific Ocean. Bioactivity-guided fractionation led to the isolation of two glycoglycerolipids, 1-palmitoyl-2-oleoyl-3-(β-D-galactosyl)-glycerol (1) and sulfoquinovosyldiacylglycerin (2). In the thallium flux assay, 1 successfully blocked the $Na_v1.7$ channel with an IC50 of 6.9 μM. Both compounds were further screened using patch-clamp electrophysiology, the gold standard for assessing ion channel activity, on human $Na_v1.7$ channel. While glycoglycerolipid 1 exhibited higher activity in the primary screen, 2 demonstrated greater potency in the follow-up assay. This study highlights a new class of $Na_v1.7$ inhibitors from marine natural products and emphasizes the potential of marine biodiversity as a valuable source for discovering potential analgesic leads targeting voltage-gated ion channels.

22.The forgotten women of Bollywood

Ankita Rathour*

Questions and concerns around the representation of women on screen have haunted major global film industries. In this talk, I turn that concern towards Bollywood–the world's largest film industry, located in India and yet severely understudied by global film scholars. I begin with the concerns around cinematic representation of Indian women post 1991, when the Indian economy liberalized. Among these concerns, over sexualization, pandering to the male gaze, the violation of the female body, and the recent rise of ultra nationalist Indian women remain predominant. However, I argue that returning to the films of the Marxist Hindi filmmaker, journalist, screenwriter, and author Khwaja Ahmed Abbas provides a solution to such concerns of representation. In this talk, I use Abbas' pivotal films like Dharti ke Laal (Children of the Soil, 1947), Saat Hindustani (Seven Indians, 1969, Aaj aur Kal (Today and Yesterday, 1947), and Call Girl (1973) to show how Abbas places his women characters in postcolonial historical materiality that should serve as an antidote to the reductionist portrayals of women in a neoliberal Indian culture. This talk aims to attract attention to the overlooked genius of Abbas for Indian and other global cinephiles and scholars alike.

23. Shake it off: The science behind untangling your headphone cables

Ishant Tiwari***, Sutikshan Bansal, Vishal Patil, Rosalind Huang, Chenyi Fei, Carlos Baez, Jörn Dunkel, Saad Bhamla**

Tangled headphone cables illustrate a broader class of materials made from many slender strands that hold together because the strands hook and braid around each other. This everyday problem matters beyond cables because similar tangles appear in bird nests, worm blobs, non-woven textiles, and soft engineered meshes, and their behavior under dynamic forcing is poorly understood. We built laboratory models of soft, randomly tangled filaments and shook them vertically at controlled frequencies while varying how tightly they intertwined. We recorded 3D trajectories and used a data-driven, reduced-order approach that finds the simplest set of equations consistent with the motion, so the model captures the main rules without unnecessary detail. The experiments reveal a frequency-controlled crossover. At some driving frequencies, the tangle moves in a disordered, chaotic way that causes the shaken filament to get pulled out of the tangle, and at other frequencies the tangle locks into coherent, localized oscillations that repeat in time. The models show that these tangles act like adjustable springs and the effective stiffness increases as the number of strand contacts increases. Simple tests with orderly soft meshes and a minimal spring–mass–damper model identify how connection pattern and grip between strands set stiffness, resonance, and energy loss. These findings explain why the right kind of vibration can promote detangling in flexible cables and they connect static entanglement to the rich dynamics seen in shaken grains. The work provides clear, testable design rules for tunable nonlinear springs and adaptive materials that could benefit soft robots, smart textiles, and structures that dissipate energy.

24. Chemo-mechanical phenomena in solid-state battery cathode composites

Elif Pinar Alsac*, **Matthew McDowell**

Solid-state batteries (SSBs) are attractive for next-generation energy storage applications due to their higher energy density, and improved safety compared to liquid-electrolyte systems. Yet, their performance is hindered by interfacial instability, mechanical degradation, and the complexity of designing cathode composites with high ionic and electronic conductivity and long-term stability. While intercalation-type oxides are commonly employed, their limited capacity and cost raise scalability concerns. Conversion-type cathodes including sulfur, transition metal sulfides, and fluorides offer much higher theoretical capacities. In liquid-electrolyte batteries, these materials suffer from dissolution and rapid capacity fade, but SSBs mitigate some of these limitations. Still, conversion cathodes face substantial chemo-mechanical challenges, including large volume changes, interfacial contact loss, and cracking. In this study, we investigate the electro-chemo-mechanical evolution of high-capacity conversion cathodes in SSBs, focusing on sulfur and transition metal sulfides. X-ray absorption and Raman spectroscopy reveal their distinct redox pathways: sulfur undergoes a two-step discharge and single-step charge, whereas sulfides exhibit complex multi-step conversions. In situ stack-pressure monitoring uncovers direct links between reaction mechanisms, pressure evolution, and electrode microstructure, with different conversion materials showing unique stress signatures during cycling. These insights highlight how chemo-mechanical coupling governs cathode degradation and performance. By correlating redox chemistry, microstructural evolution, and pressure dynamics, this work lays the groundwork for designing more robust and energy-dense conversion cathode composites for solid-state batteries.

*Denotes Presenter