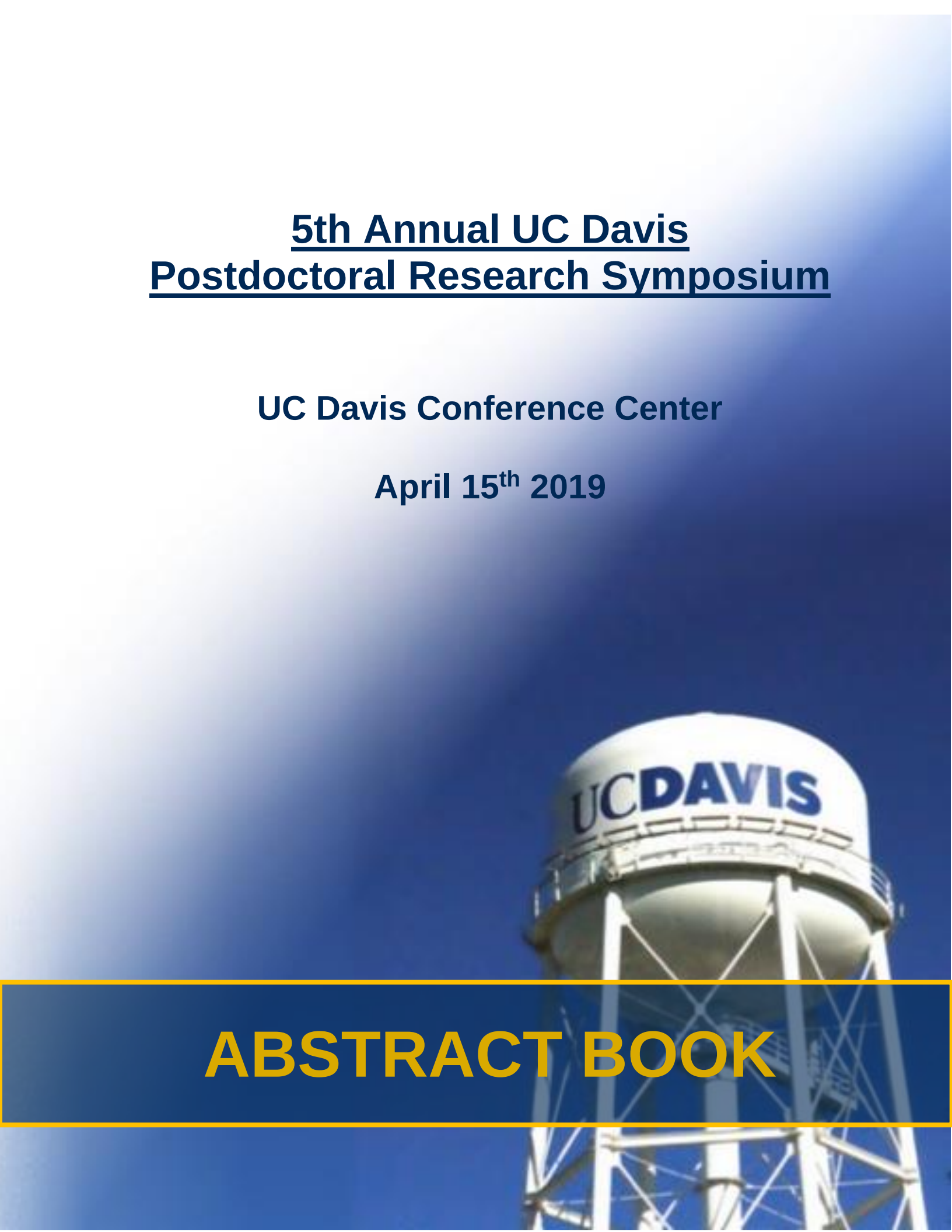
5th Annual UC Davis Postdoctoral Research Symposium

UC Davis Conference Center

April 15th 2019



ABSTRACT BOOK

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Schedule

5th Annual UCD Postdoctoral Research Symposium Agenda			
8:00-8:30	Registration and breakfast	30min	Front desk
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9:30-10:30	Poster session with coffee	1hr	Ballroom B
10:30-11:30	Talk sessions A2 & C2	1hr	Ballroom A & C
11:30-11:45	Break	15min	
11:45-12:45	Grant writing Workshop & Career Development Panel Discussion	1hr	Ballroom A & C
12:45-13:30	Lunch	45min	
13:30-14:30	Talk sessions A3 & C3	1hr	Ballroom A & C
14:30-14:45	Break	15min	
14:45-15:45	Talk sessions A4 & C4	1hr	Ballroom A & C
15:45-16:45	Workshop (Intellectual Property)	1hr	Ballroom A
16:45-17:15	Refreshment and drinks	30min	
17:15-18:15	PRS Prizes and Award Ceremony	1hr	Ballroom B+C

Program

5th Annual UC Davis Postdoctoral Research Symposium Program				
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8:00-8:30	**Registration**		**Registration**	
8:30-9:30	**Talk session A1** (20 min x 3) ▪Accelerated Machine Learning for Faster Large-Scale Protein Analysis ▪Information Transport in Quantum Materials ▪Context-dependent evaluation of evidence for decision-making	 *John Halloran* *Fabio Anza* *Rashed Harun*	**Talk session C1** (20 min x 3) ▪Effects of sugar consumption on human health and disease ▪Simvastatin Inhibits Airway Epithelial H1N1 Influenza Viral Replication ▪A modality-independent network underlies the retrieval of large-scale spatial environments in the human brain	 *Bettina Hieronimus* *Myra dela Pena-Ponce* *Derek Huffman*
9:30-10:30	**Poster session in Ballroom B**		**Poster session in Ballroom B**	
10:30-11:30	**Talk session A2** (20 min x 3) ▪Origin of volatiles in Earth's mantle ▪Organosulfates Identified in Traffic-Related Air Pollution Promote Axonal and Dendritic Growth in Primary Rat Neurons ▪Derivation of primordial germ cells from the white sturgeon, Acipenser transmontanus	 *Curtis Williams* *Rhianna K. Morgan* *Amie L. T. Romney*	**Talk session C2** (20 min x 3) ▪Controlling Heat Transfer at Nanoscale ▪Chromatin accessibility in canine stromal cells and its implications in canine somatic cell reprogramming ▪Integrated Genomic Analyses of the Effect of the Western diet on Hippocampal Microvessels in Female Mice	 *Shunda Chen* *Maria Questa* *Saivageethi Nuthikattu*
11:30-11:45	**Break**		**Break**	
11:45-12:45	**Workshop (Grant writing)**		**Career Development Panel Discussion**	
12:45-13:30	**Lunch**		**Lunch**	

13:30-14:30	**Talk session A3** (20 min x 3) ▪Marine forests, victims or heroes? Seagrass ecosystems as climate change mitigation tools ▪Modeling the survival of Salmonella on fresh cucumbers under different storage temperature and relative humidity ▪Misdirected oral behaviors in orphaned neonatal kittens	 *Aurora M Ricart* *Jiin Jung* *Mikel Maria Delgado*	**Talk session C3** (20 min x 3) ▪Creatures of habit? Laying hens show consistent behavior patterns in aviary systems ▪MicroRNA hsa-miR-324-5p suppresses H5N1 virus replication by targeting the viral PB1 and host CUEDC2 ▪A targeted approach for terminating tetramethylenedisulfotetramine (TETS)-induced status epilepticus and attenuating neurotoxicity in zebrafish	 *Christina Rufener* *Ashish Kumar* *Dennis Carty*
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14:45-15:45	**Talk session A4** (20 min x 3) ▪Convergent gain and loss of genomic islands drive lifestyle changes in plant-associated Pseudomonas ▪The lithophile element budget of Earth's core ▪Bayesian estimation of diagnostic accuracy of fecal culture and PCR-based tests for the detection of Salmonella sp. in California cull dairy cattle	 *Ryan Melnyk* *Bethany Chidester* *Pius Ekong*	**Talk session C4** (20 min x 3) ▪Topological Phase Transition in type-II Weyl Semimetal WTe2 ▪Citrus sudden death-associated virus as a new viral-based tool for translational applications ▪Toxicity of zinc oxide nanoparticles to corneal epithelial wound healing	 *Antonio Rossi* *Emilyn E. Matsumura* *Soohyun Kim*
15:45-16:45	**Workshop (Intellectual Property)**			
16:45-17:15	**Refreshment and drinks**		**Refreshment and drinks**	
17:15-18:15	**PRS Prizes and Award Ceremony**			

2019 PRS Organizing Committee

Committee Chair: Iman Jalilian

Committee Vice-chair: Shunda Chen

Committee members:
Bettina Hieronimus
Tong Shen
Abhishekh K Srivastava
Rima D Shrestha
Magdalena H Huyskens
Essam Mahmoud Abdelfattah
Prasant Jena
Silvia Keppler

Chairs:
Abhishekh K Srivastava
Bettina Hieronimus
Essam M Abdelfattah
Iman Jalilian
Rima D Shrestha
Silvia Keppler
Shruthi Krishnamurthy
Myra dela Pena-Ponce
Shunda Chen

Judges:
Abhishekh K Srivastava
Antonio Rossi
Arpana Vaniya
Bettina Hieronimus
Christina B Rufener
Jun Ding
Magdalena H Huyskens
Myra dela Pena-Ponce
Prasant Jena
Pranav Pandit
Ramon Mejia
Rima D Shrestha
Saivageethi Nuthikattu
Shunda Chen
Silvia Keppler
Tong Shen
Xi Wu
Yujing Huang

Grant Writing Workshop

11:45 – 12:45
Ballroom A

Chair: Shunda Chen

Invited speaker

Dr. Sheryl Soucy-Lubell is the Director of Interdisciplinary Research Support team in the UC Davis Office of Research. Under her direction, this team is responsible for the preparation of major grant and contract proposals for large-scale, interdisciplinary research programs. As director of this unit, Sheryl identifies and develops collaborative efforts in pursuit of extramural funding opportunities; advises campus administrators in prioritizing research efforts by determining UC Davis research capacity in specific areas and forecasting opportunities for success prior to committing resources; and conducts campus-wide research development activities such as workshops, trainings, program officer visits, funding opportunity searches and dissemination, and research team building. She received a B.A. in Biology and Environmental Studies at Dartmouth College, a Ph.D. in Ecology and Evolution at the State University of New York at Stony Brook, and conducted post-doctoral research in the Department of Biological Sciences at Florida State University.

Career Development Panel Discussion

11:45 – 12:45
Ballroom C
Chair/Moderator: Shruthi Krishnamurthy

Panelists

Dr. Marjannie Akintunde is a career advisor for master's, Ph.D. and postdoctoral scholars.

A passion to help people live better lives! This vision has been Dr. Akintunde's driving passion throughout her career. Being fascinate with the biological environment around her, Dr. Akintunde pursued a B.S. in Biology at UC Riverside and worked in a botany laboratory investigating the plant immune systems for 5 years. Having a desire to conduct~~ed~~ more applied research, Dr. Akintunde studied the immune response in mammals for her M.S. in Biology at California State University, Los Angeles. To enhance her knowledge and expertise in the immune response, Dr. Akintunde investigate how environmental chemicals impact the immune response in children with neurodevelopmental disorders, in particular, autism with Dr. Judy Van de Water. During both of Dr. Akintunde's graduate programs she further developed her passion for student affairs by serving as a mentor to both graduate and undergraduate students. She further her interactions with students by teaching multiple undergraduate classes for both science and non-science majors. Her passion for student affairs was so strong that she even developed a peer-to-peer mentor program for her graduate program to support recruitment and retention efforts. Being mindful of experiential education during her academic career, Dr. Akintunde has a vast work history with over 15 years of research and teaching experience, fellowships, training programs, as well as being an intern at the National Cancer Institute,

completing a science policy fellowship with UCSF and the US EPA, as well as working for one of the largest biopharma companies in the world, Genentech (Roche) in Product Development Regulatory Affairs. Due to her background Dr. Akintunde is well trained and knowledgeable to mentor and advise graduate students and postdoctoral scholars on all career choices and helping translate their academic training and skills to all career paths. Along with other colleagues at the Internship and Career Center, Dr. Akintunde serves as the Senior Career Advisor and leads the Career Services Program for Master's, Ph.D. and Postdoctoral Scholars (MPP) that serves over 6,000 scholars.

Dr. Teresa Dillinger, Academic Administrator, Professional Development Programs, Graduate Studies, UC Davis and Project Lead, ImaginePhD

Teresa Dillinger manages professional development programs for graduate students and postdoctoral scholars at UC Davis. She is the director of the UC Davis GradPathways Institute for Professional Development and co-director of the Professors for the Future program. She also serves on the leadership teams for faculty mentorship development program and for Leaders for the Future, a program designed to cultivate entrepreneurial thinking in graduate students and postdoctoral scholars at UC Davis. Dr. Dillinger is the nationwide project lead for ImaginePhD, an online career exploration and planning platform for humanities and social sciences PhDs, developed through the Graduate Career Consortium. Teresa Dillinger has over 20 years of experience in career and professional development advising, and is passionate about partnering with graduate students and postdoctoral scholars to help them envision and achieve their career goals. She completed both her master's and Ph.D. degrees in Geography and was a postdoctoral scholar at UC Davis before embarking upon a career in academic administration.

Dr. Monica Christina Esqueda is an Education Specialist in the Center for Educational Effectiveness (CEE). She is a member of the Learning and Teaching Support (LTS) unit. Prior to joining CEE, Monica was an Assistant Professor of Higher Education and Community College Leadership at Old Dominion University. Her research and teaching expertise include the conditions and contexts that promote access, well-being and success across secondary and postsecondary learning environments, undergraduate and graduate student development, underserved student populations, research design, quantitative research and mixed method research. She has published works in Educational Researcher, Review of Educational Research and Teachers College Record. Monica was born and raised in the San Francisco Bay Area, and is a proud graduate of the University of California system, having earned a bachelor's degree in Human Development from the University of California, San Diego. She earned a master's degree in Higher Education from the University of Washington, Seattle, and a Ph.D. in Urban Education Policy from the University of Southern California.

Niki Peterson, Senior Program Manager, Institute for Innovation and Entrepreneurship

Niki Peterson believes in being the change one longs to see in the world. In her role as senior program manager for the Institute for Innovation and Entrepreneurship, she creates a professional yet welcoming entrepreneurial platform where innovators can come together to cultivate and develop their ideas into tangible/marketable products that benefit our global society.

Dr. Rachel Reeves leads participant engagement and evaluation for the FUTURE program. Rachel previously managed the UC Davis Mellon Public Scholars Program, placing PhD researchers in consulting roles with large non-profits and state agencies. During her History PhD program, she wrote policy papers for the UC Davis Center for Poverty Research, consulted for Congressman John Garamendi's Rural Grants Initiative, and served under State Senator Lois Wolk's legislative health consultant on the 2015 End of Life Options Act. In her

research on social mobility she held fellowships with Yale, UCLA, and the University of London's School of Advanced Study. Rachel's own experience in career exploration motivates her to make PhD-level professional development accessible, equitable, and effective. She is proud to extend the impact of research at UC Davis through the successful and broad career outcomes of its researchers.

Dr. Cheemeng Tan is an assistant professor in the Department of Biomedical Engineering at the University of California Davis. He received a bachelor's degree (first class honors) from National University of Singapore and an M.S. degree in High-Performance Computing from Singapore-MIT Alliance. In 2010, he obtained a doctorate in Biomedical Engineering from Duke University. He then worked as a Lane Postdoctoral Fellow in the Lane Center for Computational Biology at Carnegie Mellon University. He has received several awards, including the Medtronic Fellowship, the Society-in-Science: Branco Weiss Fellowship, a Young Investigator Grant from the Human Frontier Science Program, the Scialog Fellow, Cellular and Molecular Bioengineering New Innovator, and NIH NIBIB Trailblazer. His research group at UC Davis aims to understand the regulatory principles of protein synthesis in cell-free systems, artificial cells, and microbes for biomedical applications.

Intellectual Property Workshop

15:45-16:45
Ballroom A
Chair: Iman Jalilian

Dr. Tucker was born in the UK and educated in Australia. He holds a B. Sc. (Hons.) and a Ph.D. in Microbiology from the University of Queensland. Dr. Tucker held post-doctoral research fellowships at Stanford University (with Prof. Stanley Cohen) and at the Research School of Biological Sciences at the Australian National University in Canberra, Australia. He also holds an MBA degree from St. Mary's College in Moraga, California.

Dr. Tucker's career began with research in agricultural biotechnology, and then transitioned to technology management and business development in the private sector. From 2003-2016 he was the Executive Director responsible for technology commercialization operations at the University of California, Office of the President. In July 2014 he was selected to be the Interim Vice President, Research and Graduate Studies during a management transition at the Office of the President. Dr. Tucker joined UC Davis as the Executive Director, Innovation Access in March 2017.

Zane Starkewolfe is the Associate Director of New Venture Resources for the UC Davis Venture Catalyst program. He works to provide support and identify early-stage funding for UC Davis researchers engaged in translational research. He has 15 years of experience in science-based entrepreneurship in the biopharma and material sciences industries. Dr. Starkewolfe previously worked at Burrill & Company, a San Francisco-based venture capital and investment banking firm focused on the life sciences, where he evaluated investment opportunities, helped raise new venture funds and advised companies on financing, business development, mergers and acquisitions, and intellectual property strategy and licensing. While at Burrill, Dr. Starkewolfe helped launch a startup developing a diagnostic platform for the assessment of neurological disorders. He previously co-founded an immuno-oncology therapeutics startup as well as a point-of-care diagnostic company based on UC Davis technology in nanomaterials and launched a digital health company. Dr. Starkewolfe obtained his Ph.D. in chemistry from UC Davis with a designated emphasis in biotechnology and clinical translational research, B.Sc. in physics, and was a UC Davis Howard Hughes Medical Institute Scholar.

Presentation Abstracts

Session A1
8:30 – 9:30 Ballroom A
Chair: Rima D Shrestha

Accelerated Machine Learning for Faster Large-Scale Protein Analysis

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Tandem mass spectrometry (MS/MS) is the most widely used technology for identifying and quantifying proteins in a complex biological sample, such as a drop of blood. Modern MS/MS experiments commonly produce millions of spectra representative of the proteins from the input sample. Owing to the noisy nature of these spectra, sophisticated machine learning methods have proven essential to reliably answer questions about the protein content of the sequenced sample. Arguably the most popular such tool for MS/MS analysis is Percolator, which utilizes a state-of-the-art machine learning method (called a support vector machine) to significantly improve the quality of protein identifications. However, improved analysis using Percolator comes at the cost of extremely long runtimes, typically increasing overall analysis time by many hours (or even days). In this talk, I will describe our recent efforts to speed up large-scale Percolator analysis through a combination of software optimization, improved machine learning algorithms, and parallelization. On a massive dataset consisting of 250 million spectra, our optimized software reduces analysis time from over three days down to just half a day. Importantly, the improved software offers compute options without degrading the quality of analysis, unlike other recently proposed approaches which trade compute time for accuracy.

Information Transport in Quantum Materials

Fabio Anza
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All natural systems have the ability to store and manipulate information. To exploit such abilities for technological purposes, it is imperative to understand their interplay with the physical properties of the underlying material. My work at UC Davis' Complexity Sciences Center is focused on building a theory to describe and understand how information can be moved across a system, depending on the properties of the material. In this presentation I will give a quick bird's-eye view on the "Classical and quantum theory of information and computation", tailored for a non-specialistic audience, and then touch upon the specific work I have been conducting.

Context-dependent evaluation of evidence for decision-making

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Decisions are based upon evidence and context, but how does context alter evidence evaluation? To investigate this question, we examined how subjects utilized evidence in a decision-making task in two contexts. 8 human subjects listened to a stream of stochastic auditory clicks and were trained to respond when there was an increase in the generative click rate or withhold from responding if there was no change. Subjects performed this task in the context of a long 1000ms (LRW) or a short 500 ms response window (SRW), where performance could be optimized by adjusting the timescale of evidence evaluation to the duration of the response window. We found that subjects' reaction times were longer in the LRW context, suggesting that subjects evaluated a broader period of recent evidence to inform choices when allotted more time to respond. Because each click is precisely timestamped relative to responses, we can also examine the time period evidence had leverage on decisions using a method called psychophysical reverse correlation. We found that decisions were informed by a broader timescale of evidence evaluation in the LRW context as expected. This work lays foundations of future experiments to examine the neural mechanisms of context-dependent decision-making.

Session C1
8:30 – 9:30 Ballroom C
Chair: Shunda Chen

Effects of sugar consumption on human health and disease

Bettina Hieronimus
SVM: Molecular Biosciences
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Obesity and obesity related diseases like the metabolic syndrome are on the rise in developing and developed countries, with cardiovascular disease being the number one cause of death worldwide. Meanwhile, we are constantly surrounded by highly palatable food and beverages that are high in sugar, salt and fat, but lack further nutritional value. We study the effects of sugar consumption on human metabolism. Our goal is to increase the knowledge of metabolic processes after sugar consumption that lead to the development of negative health outcomes. To that end we perform highly controlled intervention trials where we test metabolic markers before and after healthy men and women consume sugar-sweetened or aspartame-sweetened beverages. Results from our previous studies show that the consumption of sugar leads to increased fat synthesis in the liver, decreased insulin sensitivity and increased blood triglycerides. These effects are associated with negative health outcomes. With our current

study we are testing the hypothesis that that a diet high in sugar is harmful even in the absence of weight gain.

Simvastatin Inhibits Airway Epithelial H1N1 Influenza Viral Replication

Myra A. dela Pena-Ponce[1], Nathan E. Haigh[1], Kenneth J. Chmiel[2], Lisa A. Miller[3], Amir A. Zeki[4]

[1]California National Primate Research Center, University of California, Davis,
[2]Center for Comparative Respiratory Biology and Medicine, University of California, Davis,
[3]Anatomy, Physiology, & Cell Biology, University of California, Davis,
[4]Department of Internal Medicine, Division of Pulmonary, Critical Care, and Sleep Medicine, University of California, Davis
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Drug treatments and vaccines have not been completely effective in treating influenza (flu) infection. Thus, novel treatment modalities that target mechanisms regulating viral replication are urgently needed. Using the monkey model, we previously reported that pandemic influenza A/H1N1 virus infection results in distal airway inflammation and airway epithelial cell viral replication (AEC) in vitro. Previously, we showed that statins can be safely delivered via inhalation in monkeys achieving high airway drug distribution. Given this therapeutic potential for inhaled statins, we hypothesized that statins inhibit H1N1 influenza viral replication in primary AECs in vitro. Primary tracheobronchial epithelial cells derived from rhesus monkey tracheas were grown in bi-phasic, air-liquid interface conditions to full confluency. Cells were then pre-treated with simvastatin for 24hr followed by in vitro infection with A/California/04/2009 H1N1 virus. Simvastatin was then continued as post-treatment for an additional 48hr. Viral replication and antiviral genes were assessed by qRT-PCR. Treatment with simvastatin significantly inhibited H1N1-induced matrix gene and antiviral gene expressions in primary AECs. These results suggest a potential use of simvastatin as a therapeutic modality to prevent and/or treat flu infection. Limiting the duration and severity of the flu is clinically important to avoid further host damage and promote recovery.

A modality-independent network underlies the retrieval of large-scale spatial environments in the human brain

Derek Huffman
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Spatial navigation plays an important role in our daily lives, for example, allowing us to navigate home from our office at the end of the day. Previous research has revealed that a network of brain regions is involved in processing spatial information, for example, the distances and angles between landmarks in an environment. Our memories for large-scale spatial environments can be constructed via multi-modal cues, including visual cues (e.g., visual information related to perceiving landmarks as well as the distances and angles between such landmarks) and body-based cues (e.g., information about distances and angles can be

conveyed by leg movements and body rotations). Previous theories have posited that body-based cues fundamentally influence spatial representations in the rodent brain; however, due to technological limitations, little is known about the influence of body-based cues on spatial representations in humans. We combined novel immersive virtual reality with advanced multivariate analysis of brain imaging data. Our behavioral and brain imaging results suggest that there is a core, modality-independent network supporting spatial memory retrieval in the human brain.

Session A2
10:30-11:30 Ballroom A
Chair: Myra dela Pena-Ponce

Origin of volatiles in Earth's mantle

Curtis Williams, Sujoy Mukhopadhyay
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Constraining the source of volatiles in Earth's interior is critical as it places important constraints on planet formation models including accretion timescales, thermal evolution, volatile compositions, and planetary redox states. The 20Ne/22Ne ratio provides a powerful tool to assess the source of volatiles in Earth's interior: nebular gas, solar wind irradiated material, and CI chondrites. In this presentation, I will show new neon isotopic measurements from deep mantle plumes that are demonstrably higher than solar wind irradiated material and CI chondrites. Furthermore, these new measurements allow me to determine a primordial mantle plume source that is indistinguishable from the nebular ratio, providing robust evidence for a reservoir of nebular gas preserved in Earth's deep mantle today. The presence of nebular neon requires proto-Earth to have reached a sufficient mass within a few million years in order to capture nebular volatiles from the protoplanetary disk and dissolve them into a magma ocean. In addition, planet formation at ~1 AU in a gas-rich, nebular environment has been inferred using the Atacama Large Millimeter Array. Therefore, the capture of nebular gases could be a common feature associated with the embryo stage of terrestrial planet formation.

Organosulfates Identified in Traffic-Related Air Pollution Promote Axonal and Dendritic Growth in Primary Rat Neurons

Rhianna K. Morgan
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There is increasing evidence that traffic-related air pollution (TRAP) is an environmental risk factor for adverse neurodevelopmental outcomes. Common byproducts of fossil fuel combustion processes are organosulfates, which have been recently identified at high

concentrations in TRAP. Despite their prevalence in the environment, whether organosulfates contribute to the neurotoxic effects of TRAP has not been addressed. The objective of this study was to screen organosulfates identified in TRAP for neurotoxicity in primary neuron-glia co-cultures dissociated from the hippocampus and neocortex of postnatal rats. Phenyl sulfate, benzyl sulfate, biphenyl 4-sulfate, 4-nitrophenyl sulfate, 3-methylphenyl sulfate, glycolic acid sulfate and hydroxyacetone sulfate were tested at concentrations ranging from 10 pM to 10 μM for effects on: (1) cell viability as determined by LDH release and uptake of calcein-AM; (2) neuronal morphogenesis determined by analyses of axonal outgrowth and dendritic arborization; and (3) apoptosis measured by caspase-3 and -7 activities. Organosulfates did not alter neuronal cell viability; however, differential effects were observed on morphogenesis with dendrites being more sensitive than axons following exposure. Overall, this study suggests that organosulfates are neurotoxic constituents of TRAP that pose a potential risk to the developing human brain. Supported by NIEHS (P30 ES023513-03S1).

Derivation of primordial germ cells from the white sturgeon, Acipenser transmontanus

Amie L. T. Romney, Tawny N. Scanlan, Stuart A. Meyers
Veterinary Medicine: Anatomy, Physiology and Cell Biology
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Sturgeon are among the most primitive members of the subclass Chondrostei and represent an ancient lineage of ray-finned fishes. The white sturgeon, Acipenser transmontanus, is especially long-lived and slow growing; reaching reproductive maturity after 8 years for females. A detailed understanding of gametogenesis and sexual maturation in this species could support improved aquaculture production and faster maturation to marketability. A new technology, germ cell transplantation (GCX), includes the transplantation of gametic stem cells into alternative and less difficult spawning species. Here, we examine gonadal development, gametogenesis, and germ cell isolation for the intent of developing GCX in A. transmontanus. Histological examination revealed that ovaries from 1.5 year class females had the highest proportion of gametic stem cells and 4.5 year class females had the highest proportion of late previtellogenic oocytes across all ages examined. Females at 1.5 years were further used for evaluating gonad dissociation media for generating the highest yield of live stem cells for future GCX experiments. In summary, optimal methods for germline stem cell identification and isolation in A. transmontanus can be adapted for development of a new reproductive management tool, GCX, for hatcheries to utilize natural gamete production without genetic modification.

Session C2
10:30-11:30 Ballroom C
Chair: Essam Abdelfattah

Controlling Heat Transfer at Nanoscale

Shunda Chen [1], Aditya Sood [2,3,6], Eric Pop [2,4,5], Kenneth E. Goodson [3], Davide Donadio[1]
[1] Department of Chemistry, University of California, Davis, CA 95616, USA.
[2] Department of Electrical Engineering, Stanford University, Stanford
[3] Department of Mechanical Engineering, Stanford University, Stanford
[4] Department of Materials Science and Engineering, Stanford University, Stanford
[5] Precourt Institute for Energy, Stanford University, Stanford
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Since the discovery of the intriguing properties of 'Nobel-laureate' material graphene, research on two-dimensional (2D) layered nanomaterials has grown exponentially in the fields of physics, chemistry, biology, material science and nanotechnology. The possibility of tuning thermal conductivity and controlling heat transfer in 2D materials would open a way to significant advances in nanoscale heat manipulation, which is important for applications in next-generation electronic devices, batteries, supercapacitors, sensor, catalysis, biomedicine, etc. Here we investigate the effects of lithium intercalation, mechanical strain and phase transition on thermal conductivity of a rising-star 2D material MoS2, by First-Principles quantum calculations. Our well-converged calculations resolve discrepancies in the literature and predict the strong modulation effects on thermal conductivity of MoS2. Furthermore, we made the first electrochemical thermal transistor in the world, which can enable game changing applications in thermal management and energy harvesting. Such a breakthrough could also enable the control of heat flow using thermal circuits, in a manner analogous to electronic circuits. This study lays the foundation for electrochemically-driven nanoscale thermal regulators.

Chromatin accessibility in canine stromal cells and its implications in canine somatic cell reprogramming

Maria Questa, Maryam Moshref, Veronica Lopez C. and Amir Kol
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Use of spontaneous disease in dogs as a platform to conduct impactful and realistic translational regenerative medicine research, is very attractive given their large size, longevity, heterogenous genetics and similarity to human disease. A lack of mechanistic understanding of canine-specific regulators of pluripotency hinders robust and reproducible approaches for canine somatic cell reprogramming to induced pluripotent stem cells (iPSC).

We have reprogrammed canine fetal stromal cells to iPSC with a lentiviral system of the 4 Yamanaka factors. Nevertheless, adult stromal cells resist such an approach. Generation of iPSC depends on chromatin remodeling, entailing the inactivation of somatic enhancers and activation of pluripotency ones. We propose that a failure in chromatin remodeling constitutes a barrier to canine somatic cell reprogramming.
Through the determination of global chromatin accessibility by ATAC-seq, and gene expression by RNA-seq, in somatic and fetal fibroblasts and syngeneic ciPSC we will identify loci that are differentially accessible before and after reprogramming, identifying said reprogramming barriers, which will provide a mechanistic rationalle for enhanced, canine-specific, reprogramming protocols to support translational regenerative medicine research. Analysis of preliminary ATAC-seq data show a high number of nucleosome free regions (NFR) shared between fetal fibroblasts and iPSC, but not adult fibroblasts and ciPSC.

Integrated Genomic Analyses of the Effect of the Western diet on Hippocampal Microvessels in Female Mice

Saivageethi Nuthikattu[1], Dragan Milenkovic[1,2], John Rutledge[1], Amparo Villablanca[1]
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Hyperlipidemia is a risk factor for dementia, and chronic consumption of a Western Diet correlates with cognitive impairment. However, the molecular mechanisms are poorly understood and the degree to which sex-related differences influence the development of microvascular disease in the brain is unclear, as most prior studies have focused on males. Thus, in this study we investigate the nutrigenomic pathways by which the Western diet regulates gene expression in hippocampal brain microvessels of female mice. 5 week old female low-density lipoprotein receptor deficient (LDL-R−/−) mice and C57BL/6J wild type (WT) mice were fed a control (Chow) or Western Diet (WD) for 8 weeks. Laser captured hippocampal brain microvessels were evaluated for differential gene expression, gene networks and pathways, transcription factors, and non-protein coding RNAs by genome-wide microarray and bioinformatics. The WD resulted in increased weight, lipids, and differential gene expression of over 2000 genes (protein coding and non-coding). Networks and pathways included those regulating endothelial function and permeability especially cellular adhesion, junctional and cytoskeletal organization, cellular metabolism and cell signaling as well as potential transcription factors, particularly YY1 (Yin Yang 1) and ESR1 (EStrogen Receptor 1). We also identified differentially-expressed non-coding RNAs, primarily upregulated, including 72 microRNAs, 160 small nucleolar RNAs and 59 long non-coding RNAs, not previously described to be regulated by the WD. For all experimental groups, 4 microRNAs were in common (Mir3075, Mir329, Mir376b, and Mir 668), all down-regulated. In attempting to separate the effect of diet and genotype, the LDL-R genotype had the greatest impact, likely due to higher lipid levels. Chronic consumption of a WD resulted in complex alterations of the genomic profile of the microvasculature in the hippocampus of female mice and revealed

protein non-coding RNA as novel actors in the observed effects. Our findings underscore the importance of considering sex as a biologic variable in responses to diet associated brain microvascular pathology.

Session A3
13:30-14:30 Ballroom A
Chair: Bettina Hieronimus

Marine forests, victims or heroes? Seagrass ecosystems as climate change mitigation tools

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The increase in carbon dioxide (CO2) emissions due to fuel burning since the industrial revolution is one of the main factors contributing to climate change. As a consequence, temperatures are increasing worldwide, and the ocean is becoming more acidic. Forests can help mitigate these effects due to their capacity to sequester CO2 through photosynthetic activity. Marine forests -- coastal ecosystems dominated by seagrasses or seaweeds–may also reduce global warming by sequestering CO2 and the effects of ocean acidification (OA) by altering seawater chemistry. However, their role in OA mitigation is still equivocal, in part because the unknown spatial scale of action, and in part because marine forests are also affected by climate change.

In seagrasses specifically, we use biogeochemical and ecological approaches to evaluate their OA mitigation potential. This involves field monitoring of current physicochemical parameters in seagrass meadows along the coast of California, and a set of manipulative experiments in laboratory aquaria where we simulate different climate change scenarios.

Our results showed that seagrasses are negatively affected by warming but benefit from OA, and significantly reduce seawater acidity at local scale, thus supporting the hypothesis that marine forests can serve as tools to mitigate climate change effects.

Modeling the survival of Salmonella on fresh cucumbers under different storage temperature and relative humidity

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Introduction: There have been several multistate outbreaks of salmonellosis associated with fresh cucumbers recently in the United States. Environmental factors affect the survival of Salmonella in cucumbers and other fresh produce, but no validated models currently exist which describe the fate of Salmonella on whole fresh cucumbers.

Purpose: This study developed a mathematical model that predicts the survival of Salmonella on whole cucumbers at different temperatures and relative humidities.
Methods: Fresh cucumbers were spot inoculated with a four-strain cocktail of Salmonella enterica. Inoculated cucumbers were dried for two hours and placed in desiccators containing saturated salt (lithium chloride, potassium carbonate, and potassium sulfate) used to create controlled RH environments (~15, 50, 100 % RH) at 7, 14, and 21 °C. Samples were enumerated at appropriate time intervals ranging from 0 to 240 h. Predictive models were developed using Baranyi and Roberts model as a primary model and estimated kinetic parameters were fitted into a polynomial equation by regression analysis.
Results: The R2 values for the primary models ranged from 0.61 to 0.99. Salmonella on whole cucumbers showed better survival at higher temperature and relative humidity, with the greatest decline in Salmonella populations observed at 15% RH. The maximum death rates depended on RH and ranged from -0.009 to -0.116 log CFU/cucumber/h. Secondary models for maximum death rate and the degree of decline for Salmonella were linear, and had high R2 values (>0.98). Root mean square error values obtained for the maximum death rate (0.009) and the degree of decline (0.250) models showed that the models obtained are suitable for modeling the survival of Salmonella on the fresh cucumbers.
Significance: The models in this study will be useful for future microbial risk assessments and predictions of Salmonella behavior in the cucumber distribution chain.

Misdirected oral behaviors in orphaned neonatal kittens

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The number of hand-raised, bottle-fed orphaned neonatal kittens (ONK) has increased as shelters improve their ability to care for specialized populations. Despite this increase, we have little understanding of the potential health and welfare effects of hand-raising ONK. One problematic behavior of ONK is sucking on the bodies of littermates. Separation from the mother appears to be necessary, but not sufficient, for this behavior to develop. Misdirected oral behaviors have been well-documented in early-weaned piglets and calves, but there is little documentation of this behavior in ONK. We conducted detailed video observations of 68 fostered ONK from 23 litters and found that approximately 30% of orphaned neonatal kittens will develop or otherwise be affected by sucking behavior. Kittens sucked on littermates dozens of times per day, spending several hours a day engaged in this behavior. In addition to

behavioral observations, we conducted a national survey of foster caretakers that included 60 questions about different characteristics of the kittens that were sucking or being sucked on, as well as their environment and feeding schedules. We obtained survey data for 331 litters (1,106 kittens). Male kittens were at a greater risk than females of being a victim of sucking behavior ($X2(2)= 22.16$, $p < .001$). There was no effect of kitten sex on the likelihood of sucking on other kittens. The anogenital region was the most commonly sucked on area, and foster caretakers reported difficulty in stopping this behavior once it had begun. From our survey, behavioral observations, and communication with multiple rescue groups, some ten percent of kittens who are sucked on require some form of medical care. Results will be presented in the context of our ongoing research to address the management of misdirected oral behaviors in orphaned neonatal kittens.

Session C3
13:30-14:30 Ballroom C
Chair: Abhishekh K Srivastava

Creatures of habit? Laying hens show consistent behavior patterns in aviary systems

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Automated tracking of individual laying hens kept in modern housing systems has been challenging due to large flock size, complexity of the environment and lack of appropriate technology. The aim of this study was to objectively quantify and compare the recorded movement patterns of laying hens within a commercial system. Using a custom tracking system, we monitored the location within five zones of a commercial aviary for 13 laying hens within a flock of 225 animals for a contiguous period of 11 days. Hens manifested a hen-specific pattern that was (visually) highly consistent across days, though, within that consistency, manifested stark differences between hens. Three methods were used to classify individual daily datasets into groups based on their similarity: Linear Discriminant Analysis, Hierarchical Clustering and Hierarchical Clustering applied to dissimilarity matrices produced by Dynamic Time Warping. The three methods correctly classified more than 85% of the hen days and provided a unique means to assess the behavior of a system indicating a considerable degree of complexity and structure. This effort was the first to document movement patterns

within a large, complex commercial system and has a large potential to influence the assessment of animal welfare, health, and productivity.

MicroRNA hsa-miR-324-5p suppresses H5N1 virus replication by targeting the viral PB1 and host CUEDC2

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MicroRNAs (miRNAs) are small noncoding RNAs that are crucial post-transcriptional regulators for host mRNAs. Recent studies indicate that miRNAs may modulate host response during RNA virus infection. However, the role of miRNAs in immune response against H5N1 infection is not clearly understood. In this work, we showed that expression of cellular miRNA miR-324-5p was down-regulated in A549 cells in response to infection with RNA viruses H5N1. We found that miR-324-5p inhibited H5N1 replication by targeting the PB1 viral RNA of H5N1 in host cells. In addition, transcriptome analysis revealed that miR-324-5p enhanced the expression of type I interferon, type III interferon, and interferon-inducible genes (ISGs) by targeting CUEDC2, the negative regulator of the JAK1-STAT3 pathway. Together, the findings highlight that miR-324-5p plays a crucial role in host defense against H5N1 by targeting viral PB1 and host CUEDC2 to inhibit H5N1 replication.

A targeted approach for terminating tetramethylenedisulfotetramine (TETS)-induced status epilepticus and attenuating neurotoxicity in zebrafish

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Zebrafish have been used as a seizure model for nearly two decades; however, important questions regarding the mechanisms of seizure termination as well as persistent neurological effects are not well characterized. In this study, 5D wild-type zebrafish (Danio rerio) were used to screen positive allosteric modulators (PAMs) of γ-aminobutyric acid receptor type A (GABAAR) subunits for efficacy in terminating seizures induced by tetramethylenedisulfotetramine (TETS), a potent GABAAR antagonist and credible chemical threat agent. GABAAR subunit-specific PAMs and the positive control, midazolam (3 μM), were tested in two treatment paradigms: pretreatment for 20 min prior to the addition of 4 μM TETS, and post-treatment 20 min after 4 μM TETS. GABAAR-α2 and α2 subunit selective compounds attenuate TETS-induced status epilepticus at concentrations as low as 1 μM (SB-205384, L838417, and NS11394), while α2 subunit selective compound (TCS1105) is only efficacious at near toxic concentrations of 10 μM. These data support the hypothesis that GABAAR subunit selective compounds are as effective as benzodiazepines at terminating chemical-induced seizures and; therefore, could potentially provide neuroprotective benefits. Our future objectives will focus on GABAAR PAMs attenuating long-term neurotoxicity, such

as neuroinflammation and/or neurodegeneration following acute TETS intoxication. Supported by the NIH CounterACT program (NS079202).

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Session A4
14:45-15:45 Ballroom A
Chair: Silvia Keppler

Convergent gain and loss of genomic islands drive lifestyle changes in plant-associated Pseudomonas

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Host-associated bacteria can have both beneficial and detrimental effects on host health. While some of the molecular mechanisms that determine these outcomes are known, little is known about the evolutionary histories of pathogenic or mutualistic lifestyles. Using the model plant Arabidopsis, we found that closely related strains within the Pseudomonas fluorescens species complex promote plant growth and occasionally cause disease. To elucidate the genetic basis of the transition between commensalism and pathogenesis, we developed a computational pipeline and identified genomic islands that correlate with outcomes for plant health. One island containing genes for lipopeptide biosynthesis and quorum sensing is required for pathogenesis. Conservation of the quorum sensing machinery in this island allows pathogenic strains to eavesdrop on quorum signals in the environment and coordinate pathogenic behavior. We found that genomic loci associated with both pathogenic and commensal lifestyles were convergently gained and lost in multiple lineages through homologous recombination, possibly constituting an early step in the differentiation of pathogenic and commensal lifestyles. Collectively this work provides novel insights into the evolution of commensal and pathogenic lifestyles within a single clade of host-associated bacteria.

The lithophile element budget of Earth's core

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The compositions of Earth’s core and mantle were set during metal–silicate equilibration as the planet grew and differentiated. The conditions under which core formation occurred are yet to be fully understood and experiments that simulate core formation are vital for our understanding of the dynamics of planet formation. We completed metal–silicate partitioning experiments on major, minor, and trace lithophile elements (Mg, Al, Ca, Si, S, O, U, Th, K) to 85 GPa and 5400 K to parameterize their partitioning as a function of pressure, temperature, oxygen fugacity, and chemical composition. By utilizing a Monte Carlo fitting approach, we

robustly account for all experimental and analytical uncertainties in our parameterization. Our parameterization can be used in planetary growth models to constrain Earth's accretional history by comparison to the compositions of Earth's core and mantle. Furthermore, by determining to what degree different elements may have partitioned into the core we can gain a better understand the energy budget of Earth's core.

Bayesian estimation of diagnostic accuracy of fecal culture and PCR-based tests for the detection of Salmonella sp. in California cull dairy cattle

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Salmonella is an important foodborne pathogen of significant public health concern. It is shed in feces of clinically healthy cattle and can potentially contaminate beef products. The objective of this study was to estimate the diagnostic accuracy of culture and PCR-based tests for detection of Salmonella in feces of culled cattle on California dairies using individual cow fecal samples, pools of 5 fecal samples or 5 enriched fecal broth culture. Fresh fecal samples were collected from 240 cows on five dairies between 2015 and 2016. Three sample types—individual, pooled fecal, and enriched fecal broth pools—were tested for Salmonella using culture and a combined PCR and culture test. Sensitivity (Se) and specificity (Sp) of both tests were estimated using Bayesian latent class analysis assuming dependence between the tests. The diagnostic tests have comparable Se and Sp for the three sample types. At the individual cow-level, Se and Sp of both tests range from 90-100%. For fecal pools, Se of both tests range from 75-100%, Sp range from 94-100%. For fecal broth pools, Se of both tests range from 84-100%, Sp range from 93-100%. The diagnostic tests evaluated showed high and comparable accuracy in the individual and pooled samples.

Session C4
14:45-15:45 Ballroom C
Chair: Essam Abdelfattah

Topological Phase Transition in type-II Weyl Semimetal WTe2

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Multifunctional quantum materials are important for realizing critical phenomena, manifesting novel switching behavior, and producing robust interface physics. The multifunctionality of 2D materials is exemplified by WTe2 which is a type-II Weyl semimetal with non-saturating magnetoresistance in its bulk, transforming into a superconductor under hydrostatic pressure, or transforming into a quantum spin hall insulator (QSHI) in its monolayer limit, which can be tuned to a superconductor with electrostatic gating. In many of these transformations, the tuning of the carrier density has been shown to play an important role. Here we demonstrate a non-trivial non-monotonic change in electronic structure of WTe2 upon in-situ alkali metal dosing, realizing an interface field effect as a pathway for tuning behavior of 2D materials.

Citrus sudden death-associated virus as a new viral-based tool for translational applications

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Citrus sudden death-associated virus (CSDaV) has been associated with citrus sudden death (CSD) disease in Brazil. Difficulties in purifying CSDaV virions from infected citrus plants have prevented progress in studying the role of this virus in CSD and in understanding its molecular biology. In this work, we have constructed an efficient CSDaV infectious clone that is able to locally-infect Nicotiana benthamiana plants via Agrobacterium tumefaciens inoculation, generating high amounts of viral particles only 2 days post inoculation. Using N. benthamiana as a model, we show that CSDaV produces three forms of the capsid protein (CP), and not only two as reported by others; we revealed the strategies/mechanisms used by CSDaV for efficient replication and expression of the CPs, and we show that the CSDaV infectious clone can be modified to express a foreign protein. Together, these findings contribute to advancing our understanding of CSDaV molecular biology and represent an important step toward using this virus as a vector for translational applications, such as to understand CSD etiology or induce desirable traits in citrus plants, citrus pathogens or even insect vectors of citrus pathogens to improve citrus health.

Toxicity of zinc oxide nanoparticles to corneal epithelial wound healing

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The cornea is a major route of exposure from aerosolized nanoparticles. Furthermore, many commercially available facial products contain zinc oxide nanoparticles (ZnO-NP). However,

there is a knowledge gap regarding the effects of ZnO-NP on the cornea. The purpose of this study was to determine the effects of ZnO-NP on the cornea with or without wounding. MTT and migration assays were performed following treatment with ZnO-NP (50nm;0.01-250μg/mL) for 24h. ZnO-NP (50μg/mL) and vehicle were topically applied 6 times daily after epithelial debridement in vivo rabbits to test their effects to the epithelial wound healing. Fluorescein stain was performed twice daily to monitor the wound area. After euthanization, hyperspectral microscopy was performed on histologic sections of the eyes to determine penetration of ZnO-NP. One-way ANOVA followed by Holm-Sidak's multiple-comparison test was used for statistical analysis. Cell viability and migration were significantly decreased with ZnO-NP at ≥5 μg/mL ($P<0.001$ and $P<0.05$, respectively). Epithelial wound healing was significantly slower in rabbits treated with ZnO-NP ($P<0.001$) versus control. Hyperspectral images demonstrated that more ZnO-NP penetrated through all layers of the wounded corneas. Exposure of ZnO-NP to the wounded cornea can inhibit corneal epithelial cell migration and may result in accumulation to ZnO-NPs within the eye. Supported by NIEHS U01 ES027288.

Poster Presentations

9:30-10:30 Ballroom B

1. Hepatic arterial tree segmentation: Towards patient-specific dosimetry for liver cancer radioembolization

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Liver cancer is among the deadliest cancers and its mortality rate is increasing in the United States. Y-90 radioembolization is increasingly being used for the treatment of advanced liver cancer. Accurate pretreatment dosimetry is necessary to determine the Y-90 activity to inject in order to maximize the dose to the tumor while limiting the dose to surrounding healthy parenchyma. Current dosimetry methods are not accurate nor precise, because they do not consider the non-uniform Y-90 microsphere distribution in the hepatic arterial (HA) tree as well as HA anatomy variations among the patients. We are addressing this problem by developing a patient-specific approach combining computational fluid dynamics (CFD) simulation carried out for each patient's anatomy and Y-90 microsphere decay physics to estimate the amount of dose delivered to different liver tissues more accurately. This study aims at providing a pipeline for extracting HA geometry from cone beam computed tomography images as the first step of our dosimetry approach. Our pipeline provides the fluid domain of interest needed for the CFD simulation for each patient. Future works will focus on predicting the radioactive microspheres distribution in HA branches through CFD simulation, which in turn can help developing a more patient-specific dosimetry approach.

2. Regulation of Cav1.2 by PKC signaling

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L-type calcium channels (LTCC) mediate calcium entry into cells which regulates diverse functions in different cell types, including cell contractility in cardiomyocytes and smooth muscle cells, as well as gene expression and long-term potentiation in neurons. The activity of LTCC Cav1.2 is critically regulated by phosphorylation and dephosphorylation of sites on its intracellular domains. Cav1.2 regulatory pathways by protein kinase A (PKA) have been studied extensively. On the contrary, its regulation by protein kinase C (PKC) is more obscure. PKC can have positive, negative, or biphasic effects on Cav1.2 channel activity. Here we compare the regulation of Cav1.2 by PKA versus PKC. Whereas PKA acts by directly phosphorylating Cav1.2, PKC acts through the non-receptor tyrosine kinases Pyk2 and Src. We show that Pyk2 and Src co-immunoprecipitate with Cav1.2 from brain. Pyk2 binds to the intracellular loop between domains II and III. In PC12 cells, which express Cav1.2 and the Gq-coupled bradykinin receptor B2, stimulation of the B2 receptor, as well as direct activation of PKC by a phorbol ester, increases tyrosine phosphorylation of α11.2, both of which can be blocked by the Pyk2/FAK inhibitor PF-431396. The tyrosine phosphorylation of α11.2 induced by phorbol ester is also sensitive to Src inhibitors. To investigate the physiological significance

of PKC activation of Cav1.2, we studied L-type calcium currents in mesenteric vascular smooth muscle cells (mVSMCs) and neurons. Phorbol ester stimulation results in a 2-fold increase in L-type whole-cell barium current in mVSMCs, which is completely blocked by PF-431396 and Src inhibitors. In neurons, single-channel recording revealed an increase in L-type channel open probability (NPo) by PKC stimulation, which can be blocked by PF-431396. Taken together, our data shows an upregulatory role of PKC activation on LTCC activity mediated through tyrosine phosphorylation by Pyk2 and Src. The work provides mechanistic insight on PKC regulation of Cav1.2, which has direct relevance for the control of basic physiological functions such as gene expression, vascular contractility, and synaptic plasticity.

3. Development of faux-biotics to prevent CRE colonization after antibiotic treatment

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Severe disruption of the gut microbiota with multiple broad-spectrum antibiotics predisposes patients in the intensive care unit to develop carriage and nosocomial infection with carbapenem-resistant Enterobacteriaceae (CRE), such as Klebsiella pneumoniae and Escherichia coli, which are classified by the Centers for Disease Control as one of the most urgent threats to public health. Whereas inoculation of mice with a probiotic mixture of Clostridia and commensal Enterobactericeae restores niche protection against CRE, this can only be accomplished after cessation of antibiotic treatment, because probiotic microbes are sensitive to antibiotics. Here we tested whether microbes can be functionally replaced by drugs, termed faux-biotics, to restore colonization resistance. We found that Clostridia contribute to colonization resistance against CRE by activating epithelial PPAR-γ-signaling and could be functionally replaced by a faux-biotic, the PPAR-γ agonist 5-amino salicylic acid (5-ASA). Streptomycin-treated mice given 5-ASA together with the probiotic E. coli Nissle 1917 were protected from colonization with CRE, whereas treatment with 5-ASA alone or E. coli Nissle 1917 alone conferred little protection. These results provide a proof of concept that faux-biotics represent an alternative to the use of probiotics or fecal microbiota transplants, thereby opening the door to develop approaches that can be used concurrently with antibiotic therapy to alleviate unwanted adverse effects.

4. Cortical interlaminar astrocytes in mammalian evolution and development

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Interlaminar astrocytes (ILA) are a subtype of astrocytes present in the cerebral cortex, with a soma in layer I and long interlaminar processes running perpendicularly to the pia into deeper cortical layers. We are interested in the study of ILA in evolution and development of the cerebral cortex, across different mammalian species. We examined cerebral cortex from 46 species encompassing most orders of therian mammalians, including 22 primate species. We described two distinct cell types with interlaminar processes that have been previously referred to as ILA, that we named pial ILA and subpial ILA. ILA cell types have different somatic morphology, position in layer I, and presence across species. We described “rudimentary pial

ILA", with short GFAP+ processes that do not exit layer I, and "typical pial ILA", with longer GFAP+ processes crossing layer I-II border.We found that pial ILA were present in all mammalian species analyzed, with typical ILA observed in Primates, Scandentia, Chiroptera, Carnivora, Artiodactyla, Hyracoidea, and Proboscidea. Subpial ILA were absent in Marsupialia and typical subpial ILA were only found in Primates. We confirmed ILA astrocytic nature by investigating their molecular properties. We found that while the density of pial ILA somata only varied slightly, the complexity of ILA processes varied greatly across species, reaching the highest values in primates, specifically bonobo, chimpanzee, orangutan, and human. ILA were known to be present and develop mainly postnatally, but when exactly they appear during development is not known. We assayed ILA appearance and differentiation during development, by inspecting specific prenatal and postnatal developmental stages of mouse, rhesus macaque, chimpanzee and human. We found an increasing morphological complexity throughout development, in both species. Data obtained from this project will shed light on the ILA role in the evolution and development of the cerebral cortex. We will next unravel the molecular mechanisms responsible for the appearance of ILA in primate and specifically in the human cerebral cortex.

5. Comparison of CRISPR-based genome editing of VEGF-A as treatment strategy for choroidal neovascularization

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Choroidal neovascularization (CNV) is implicated in many retinal diseases including neovascular age-related macular degeneration. RNA-mediated clustered regularly interspaced palindromic repeats (CRISPR) genome editing holds the promise for permanent suppression of potent angiogenic factors such as vascular endothelial growth factor (VEGF), but the optimal approach is unclear. Here, we compare the efficacy of two widely-used Cas9 endonucleases; S. Pyogenes (SpCas9), and S. Aureus Cas9 (SaCas9) to target the VEGF-A gene in mouse.Genome editing efficiencies in vitro were similar for dual-vector SpCas9 (30-32%) and single-vector SaCas9 (33-34%) in NIH3T3 cells, using guide RNAs with the highest on-target score for each ortholog ($P>0.05$). However, subretinal AAV8-mediated delivery of Cas9 orthologs in mouse eyes revealed that in vivo editing frequencies for SpCas9 was greater than SaCas9 (4.3% vs. 1.5%; $P<0.05$). In addition, VEGF protein production was reduced to 34% ($P<0.05$) in eyes received SpCas9, but was not significant for SaCas9 ($P>0.05$). Laser-induced CNV showed more effective reduction in CNV size in the eyes received SpCas9 (32%, $p<0.05$) compared to SaCas9 ($P>0.05$). Our results showed that dual-vector AAV8 delivery of SpCas9 appears superior in efficacy compared to single-vector SaCas9 for genomic editing of VEGF-A in mouse eyes.

6. Ascorbic acid and TGF-β1 differentially modulate composition, structure and mechanical properties of the corneal endothelial extracellular matrix

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Alterations in the protein composition of the extracellular matrix (ECM) markedly influence cell functions which may promote progression of diseases such as cancer and fibrosis. In this study, we comprehensively investigated the effect of two main signaling molecules, transforming growth factor (TGF)-β1 and ascorbic acid (AA), on the composition, structure and stiffness of the ECM produced by primarily cultured bovine corneal endothelial cells (BCECs). BCECs were seeded on glass slides for up to six weeks. Untreated samples were used as a control. ECM structure was determined using immunocytochemistry. The stiffness and protein composition of the ECM were measured using atomic force microscopy (AFM) and proteomics technique, respectively. Immunostaining of the ECM showed an increase in collagen and fibronectin expression in samples treated with AA or TGF-β1 compared to controls. AFM results showed a significant decrease in the stiffness of the samples treated with TGF-β1 compare to the controls. A total of 502 proteins were differentially expressed in AA-treated cells as detected by proteomics analysis. By contrast, only 33 differentially expressed proteins were identified for TGF-β1-treated cells. Multilayered analysis revealed distinct pathways for AA and TGF-β1 signaling that engaged in tissue development, cell migration and glucose uptake.

7. Uncovering station roles in urban bike share

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Urban spatial networks are complex systems that reflect the interdependent roles of neighborhoods and methods of transportation between them. Functional neighborhood divisions can be difficult to identify, especially as individual work styles become more diverse, and cities evolve from monocentric to polycentric organization. To ease the daily commute an effective urban plan should incorporate real-time detection of office and residence regions based on data from public transportation, pedestrian flow and other sources.Here we classify docking stations in bike-share networks to gain insight into the spatial delineations of three major U.S. cities. The temporal structure of the data requires the use of time-dependent network models over spatially fixed nodes. We propose a time-dependent stochastic block model to detect the roles served by stations and describe the traffic within and between blocks over the course of a day. Both discrete and continuous role assignment are considered. Our models produce elegant descriptions of daily commuting patterns. They also reveal how the functional roles of bike-share stations are influenced by surrounding public transportation infrastructure and land-use designations encoded in zoning ordinances. Our work proposes a new community detection layer that can be incorporated in multilayer networks of urban transportation. It has direct application to the design and maintenance of bike-share systems, but also potential for wider applications to temporal networks.

8. Plant nutrient stress drives the up-slope shifts of wood species under warming climate

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Understanding drivers of species distribution shift is critical to predict future species dynamic in the changing climate. Although the climate change is leading to species distribution shift (e.g., the warming climate is expected to cause upslope shift of plant communities), the distribution shifts differ between species, as both upslope and downslope shifts were detected in recent studies. These species-specific shifting directions suggest that, in addition to warming effect, there are some unknown factors involved. Therefore, investigating these factors can largely improve mechanistic understanding of species response to changing climate. According to species-specific response to plant water and nutrient stress, this study, for the first time, examined the effects of water and nutrient stress simultaneously on the distribution shifts. Eight dominant woody species with different shift directions (two downslope-, three upslope- and three non-shifting species) were used. The plant water and nutrient stress were estimated by foliar carbon and nitrogen isotope ratios (δ13C and δ15N values) in conjunction with other measurements of foliage and soil parameters from 16 permanent plots along an elevational gradient. Lower soil water content was found at the lower elevations, which led to higher water stress to both the upslope versus downslope shifting species, as indicated by their higher foliar δ13C values at low elevations. Similarly, lower soil fertility was also found at the lower elevations, which led to higher nutrient stress, but only to upslope-shifting species, as indicated by their lower values of δ15N and leaf N content at low elevations. Non-shifting species did not show any significant stress patterns with elevation. Together, the only observed difference between upslope versus downslope shifting species was nutrient stress. The different nutrient stress response highlight the primary role of nutrient stress on explaining species shifting direction. Thus, ongoing warming climate may exacerbate upslope shift of the nutrient sensitive species.

9. Effect of particle size and friction on binary granular shear flows of inelastic grains

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In this study, shear flows of binary granular systems with various particle sizes and particle friction are modeled using discrete element method in order to explore these effects on the stress behavior. It is found that the stress increases with increasing inter-particle friction until it reaches an asymptote when particles rotate freely. The rotation of particles in shear flows can be restrained in the simulations by incorporating rolling friction or by specifying a large moment of inertia for each particle, in order to account for the effect of an irregular particle shape. Stresses for rotational particles are found to be lower than those for non-rotational particles, as translational energy is partially converted into rotational energy. In addition, for different solid fraction ratios and size ratios, different types of particle-particle contacts (e.g. large-large particle contact, large-small particle contact, and small-small particle contact) play the dominated role. Therefore, the effect of inter-particle friction on shear stress is related to

the number and type of particle contacts which is in turn determined by the solid fraction ratio and particle size ratio.

10. Understanding flavivirus NS5 antagonism of innate immunity in human

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Arthropod-borne flaviviruses, are responsible for severe epidemics in humans. In the last ten years, we have seen the emergence of Zika virus and continued endemic infections by dengue virus, which cause severe illness or death in human. Understanding flavivirus immune evasion is critical because of their large impact on human health. Recently, we showed that dengue virus NS5 protein inhibits the expression of immune response genes through an interaction with PAF1C. PAF1C is a transcription elongation factor that promotes immune gene expression, which we found inhibits flavivirus replication. Based on proteomic data, we hypothesize that a physical interaction between PAF1C and NS5 allows NS5 to antagonize PAF1C. To test this hypothesis, we created dengue virus NS5 truncation mutants and identified the region of NS5 responsible for the interaction with PAF1C, indicating that substantial nuclear localization is not required for the interaction. We further aimed to determine the breadth of the NS5-PAF1C interaction among flaviviruses. Surprisingly, we found the NS5-PAF1C interaction to be conserved across flaviviruses, including tick-borne virus. Our results suggest that some low level of NS5 nuclear localization is sufficient to antagonize PAF1C and may explain why NS5 nuclear localization sequence is broadly conserved in a positive-stranded RNA virus.

11. Snowball earth - timeline of a frozen planet

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In the Earth's distant past, ~720-635 million years ago, two major glaciations covered the entire planet with snow and ice, a period called Snowball Earth. The prevailing hypothesis suggests that the Earth entered a frozen state due to a runaway cooling effect initiated by low amounts of greenhouse gasses in the atmosphere. Initial cooling caused snow and ice cover in high latitudes, which in turn reflected more sunlight, and lead to further cooling. Once the Earth entered this fully frozen state, it took a long time (several millions of years) for greenhouse gasses of volcanic origin to build up in the atmosphere, leading to rising temperatures. Once the greenhouse gasses reached a tipping point, melting of the ice occurred catastrophically (<1000 years). Following the deglaciation, the level of oxygen in the atmosphere increased and lead to the rise of algae and animals in the ocean. We tested parts of this hypothesis with geochronology by dating volcanic deposits overlying glacial sediments. Both glacial episodes are indeed long lived with a duration of >4 million years and the ice melted rapidly for the last glaciation. Our results thus provide support for the Snowball Earth hypothesis.

12. Bile acids and steroids combined targeted analysis using high resolution liquid chromatography mass spectrometry

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Bile acids and steroid hormones are derived from cholesterol metabolism and play fundamental roles in many physiological processes. Bile acids are the intermediates and signaling molecules between liver and gut microbiota. Steroids regulate broad aspects of metabolism, such as sexual characteristics, reproduction, and neurological functions. While quantitative assays for bile acids and steroids increase in demand in research and clinical practice, these compounds are usually analyzed in separate assays. A range of biologically important isomers are present in human and other mammalian samples, due to endogenous biosynthesis as well as biochemical modification pathways. All these result in the complexity for the analytical measurement. Here, we present a combined high resolution tandem mass spectrometry (MS/MS) coupled with ultra-high-performance liquid chromatography (UHPLC) method to analyze biological 33 bile acids and 40 steroids within an 18 minute run time using polarity switching and parallel reaction monitoring (PRM), including resolving a range of chemical isomers.

13. Unique photochemo-immuno-nanoplatform against orthotopic xenograft oral cancer and metastatic syngeneic breast cancer

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Sophisticated self-assembly may endow materials with a variety of unique functions that are highly desirable for therapeutic nanoplatform. Herein, we report the coassembly of two structurally defined telodendrimers, each comprised of hydrophilic linear PEG and hydrophobic cholic acid cluster as a basic amphiphilic molecular subunit. One telodendrimer has four added indocyanine green derivatives, leading to excellent photothermal properties; the other telodendrimer has four sulfhydryl groups designed for efficient intersubunit crosslinking, contributing to superior stability during circulation. The coassembled nanoparticle (CPCI-NP) possesses superior photothermal conversion efficiency as well as efficient encapsulation and controlled release of cytotoxic molecules and immunomodulatory agents. CPCI-NP loaded with doxorubicin has proven to be a highly efficacious combination photothermal/chemotherapeutic nanoplatform against orthotopic OSC-3 oral cancer xenograft model. When loaded with imiquimod, a potent small molecule immunostimulant, CPCI-NP is found to be highly effective against 4T1 syngeneic murine breast cancer model, particularly when photothermal/immuno-therapy is given in combination with PD-1 checkpoint blockade antibody. Such triple therapy not only eradicates the light-irradiated primary tumors, but also activates systemic antitumor immunoactivity, causing tumor death at light-unexposed distant tumor sites. This coassembled multifunctional, versatile, and easily scalable photothermal immuno- nanoplatform shows great promise for clinical translation.

14. Calibration and global sensitivity analysis for a salinity model used in evaluating fields irrigated with treated wastewater in the Salinas valley

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Treated wastewater irrigation began two decades ago in the Salinas Valley of California and provides a unique opportunity to evaluate the long-term effects of this strategy on soil salinization. We used data from a long-term field experiment that included application of a range of blended water salinity on vegetables, strawberries and artichoke crops using surface and pressurized irrigation systems to calibrate and validate a root zone salinity model. We first applied the method of Morris to screen model parameters that have negligible influence on the output (soil-water electrical conductivity (ECsw)), and then the variance-based method of Sobol to select parameter values and complete model calibration and validation. While model simulations successfully captured long-term trends in soil salinity, model predictions underestimated ECsw for high ECsw samples. The model prediction error for the validation case ranged from 2.6% to 39%. The degree of soil salinization due to continuous application of water with electrical conductivity (ECw) of 0.57 dS/m to 1.76 dS/m depends on multiple factors; ECw and actual crop evapotranspiration had a positive effect on ECsw, while rainfall amounts and fallow had a negative effect. A 50-year simulation indicated that soil water equilibrium (ECsw $\leq$ 2dS/m, the initial ECsw) was reached after 8 to 14 years for vegetable crops irrigated with ECw of 0.95 to 1.76. Annual salt output loads for the 50-year simulation with runoff was a magnitude greater (from 305 to 1028 kg/ha/year) than that in deep percolation (up to 64 kg/ha/year). However, for all sites throughout the 50-year simulation, seasonal root zone salinity (saturated paste extract) did not exceed thresholds for salt tolerance for the selected crop rotations for the range of blended applied water salinities.

15. Understanding deterioration of fresh-cut lettuce under modified atmosphere packaging

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The mechanism determining the rate of deterioration has not been identified, though a major determinant locus (qSL4) has been detected on chromosome 4. By investigating the effect of modified atmosphere packaging (MAP) composition, we found that high respiration induced by low O2 (< 1%) was highly associated with tissue deterioration. RNAseq analysis using rapidly deteriorating (i.e. La Brillante: LaB) and slow deteriorating (Salinas 88: S88) cultivars revealed that transcriptomic changes mainly occurred in the initial stage of deterioration rather than later. Consistent with shelf life tests, genes associated with cellular respiration were expressed differently in LaB and S88 during storage. Genes involved in glycolysis such as two ATP consuming enzymes (fuctokinase, FK and hexokinase, HXK) and major components of electron transportation chain (ETC) including complex I and IV, and ATP synthase coding genes were up-regulated in LaB but down-regulated in S88. Two alternative oxidase (AOX) genes that deliver electrons to ETC to reduce oxygen without generating ATP displayed significantly higher expression in S88. These results suggest that susceptibility of cultivars to low oxygen could determine their shelf life. When in low oxygen environment, slow deteriorating varieties (e.g. S88) maintain the quality by reducing the consumption of sugars

(e.g. sucrose) and energy (e.g. ATP) and cellular activity including energy production, while rapidly deteriorating varieties (e.g. LaB) act in the opposite manner.

16. Longitudinal study on antimicrobial treatment and resistance in adult cattle on California dairies

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Californians have a secure and ample supply of dairy products due to the health of their dairy cattle. Using antibacterial drugs for the prevention and treatment of diseases comes with the risk of bacterial resistance affecting both cattle and humans, which is a serious global issue. Understanding the pathways between on-farm drug use and antimicrobial resistance (AMR) in dairy cattle populations is key to antibiotic stewardship and judicious use. Our objective is to assess the impact of AMR legislation on CA dairies. The study will be conducted over two cohorts (winter and summer of 2019) in 10 California dairies (Northern California, San Joaquin Valley, and the Greater Southern California). Fecal, milk, lagoon samples will be collected on a monthly basis 60 days before calving to 120 days in milk. Escherichia coli and Enterococcus spp. will be isolated and tested against a panel of antimicrobial drugs. The winter cohort is completed, and the summer cohort will start in March 2019. We estimate that we will have 4800 isolates to determine the changes in bacterial resistance in response to these drugs in adult dairy cattle. Additionally, we will determine the relation between the drug use records of each dairy with the AMR.

17. Vaporizing planets and building moons via giant impacts

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Collisions between planetary bodies are a key process in the formation of planets, both in the history of our own solar system and in planetary systems around other stars. These impacts can have a major effect on growing planets, changing their structure and potentially altering their compositions. Understanding planetary evolution, particularly for the Earth, thus requires an understanding of such impacts. Giant impacts between planets in their final stages of growth have sufficient energy to melt and vaporize a huge mass of rock. The new planetary object formed by such an impact may have key consequences for the evolution of the Earth and the formation of Earth's moon. Here I will discuss the growth of planets via collisions, the energies involved in giant impacts, and the formation of the Moon.

18. Delivery of an Artificial Transcription Factor and a RNA-targeting nuclease for Angelman Syndrome using AAV-PHP.eB

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Angelman Syndrome (AS) is a neurogenetic disorder that arises from the genetic loss of the maternal UBE3A gene in the brain neurons, causing severe mental and physical impairments. The paternal allele has an intact UBE3A allele, but due to a brain-specific long non-coding RNA transcript, known as the UBE3A-antisense (UBE3A-ATS), paternal UBE3A remains silenced. Reactivation of the paternal allele could therefore restore UBE3A expression in the brain. One of the strategies for achieving reactivation is to repress the UBE3A-ATS. Previously in the Segal lab it was shown that a zinc finger-based artificial transcription factor (ATF) called S1K, targeting the promoter of the Ube3a-ATS transcript, was able to repress the antisense strand and reactivate Ube3a transiently in the brain of a mouse (Bailus et al., 2015). More recently, a new nuclease Cas13b targeting RNA directly was characterized (Cox et al, 2017) demonstrating the potential of using it in the development of RNA targeting therapeutics. Here we are comparing the proposed novel strategies for unsilencing the paternal Ube3a. First, by improving S1K to achieve long-term UBE3A expression in the brain, and secondly, testing for the first time the nuclease Cas13b to target the antisense directly to unsilence UBE3A expression from the paternal allele. To deliver both therapeutics and to achieve long-term expression, an adeno-associated virus with an improved capsid for enhanced neuronal transduction: AAV-PHP.eB (Chan et al., 2017) was administrated intravenously in Ube3a-YFP animals. Preliminary data will be presented on the safety and distribution of the two different unsilencing strategies using AAV-PHP.eB as the vector for delivery. After first evaluation of the different therapeutics, different routes of the proposed epigenetic therapy will be evaluated, and the most promising approach will be tested for the duration of Ube3a activation and behavioral rescue in a mouse model of AS.

19. The link between meaning and form: how we learn and decode language

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An essential rule to decode language is to understand how meaning is mapped onto the form. For example, when we hear the sentence “the girl hugged the baby”, we immediately know that the subject (the girl) is the “hugger” (the actor) and the object (the baby) is the “huggee” (the acted-on). This example shows that there is a one-to-one mapping between meaning and form: the subject of a sentence is the actor and the object is acted-on. This regularity enables language users to comprehend and learn languages. However, this rule falls apart in intransitive sentences. For example, the boy in “the boy jumped” was the actor (he did the action) while in “the boy fell”, he was acted on and did not fall intentionally. Previous researchers assumed that these two types of intransitive sentences are decoded differently. We examined how English speakers interpret these two types of sentences in two eye-tracking studies. Psycholinguistic research has shown that if the participants decode the sentences in different ways, their eye fixation behaviors differ. We did not find such a difference. This leads us to a new mapping rule between meaning and form which we will discuss in the presentation.

20. Do fish have ears?

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Fish ear bones, called otoliths, are calcium carbonate structures in the inner ear of most bony fishes and function to detect sound, water pressure and depth. Otoliths form continuously throughout the life of a fish and accrete daily layers, similar to the annual rings found in trees. The sequence of these layers can be used to determine the age of a fish and the otolith shape can be used to identify distinct species. In addition, the chemical signatures in otoliths can be analyzed and correlated with the chemical signatures of the water and food that the fish utilized. This provides us with a powerful tool to track the movement of fish between different habitats, along rivers and estuaries, and migrations into the ocean. Here we present on our ongoing efforts to study the otolith chronology and chemistry of endangered and threatened fishes in California, including the Chinook Salmon, and Delta and Longfin Smelt. We use our findings to better understand how fish abundance and life history in the San Francisco Estuary is related to environmental parameters such as freshwater outflow and temperature, which in turn informs management and conservation efforts.

21. NRAMP1 is critical for neutrophil-mediated control of *Salmonella typhimurium*

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The Natural resistance associated macrophage protein 1 (NRAMP1), is important for defense against intracellular pathogens. NRAMP1 is a phagosomal transporter of iron and manganese. Conventional wisdom holds that macrophage control of intracellular pathogens is facilitated by metal withholding in the phagosome via NRAMP1 activity. We have found that a different host cell type, the neutrophil, was responsible for NRAMP1-mediated control of an intracellular bacterial pathogen. We investigated how vitamin A deficiency impairs control of systemic Salmonella infection in a mouse model. Mice with a loss-of-function mutation in the NRAMP1 encoding gene Slc11a1 were equally susceptible to systemic salmonellosis as vitamin A-deficient, NRAMP1-proficient, animals suggesting that control of disseminated Salmonella was dependent on NRAMP1 expression under vitamin A replete conditions. Consequently, Vitamin A deficiency in NRAMP1-proficient mice impaired infection-induced granulopoiesis, resulting in reduced expression of specific- and gelatinase granule components in neutrophils, including NRAMP1. Adoptive transfer of neutrophils from NRAMP1-proficient donors, but not from NRAMP1-deficient donors, reduced systemic Salmonella burden in vitamin A deficient NRAMP1-proficient mice. Additionally, NRAMP1-deficient neutrophils had a diminished capacity for controlling Salmonella growth ex vivo compared to NRAMP1-proficient neutrophils. Collectively, these data suggest that NRAMP1-deficiency impairs control of intracellular pathogens by blunting neutrophil-mediated host defenses.

22. NMR-based metabolomics as an early detection strategy in the battle against citrus greening disease

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Citrus Greening Disease (more commonly known as Huanglongbing; HLB) is a severe, incurable disease affecting citrus plants and is caused by the bacterium Candidatus Liberibacter asiaticus (CLas). The most frequent route of transmission occurs by insect feeding, specifically via the Asian Citrus Psyllid (ACP). Currently, HLB disease management relies on detecting the pathogen at the earliest stage of infection possible in order to prevent disease spread. In a greenhouse study, Lisbon lemon trees were exposed to ACP that were either carriers of CLas (Exposed: n = 10), or non-carriers (Control: n = 6). Metabolites in leaves were tracked for 1 year using 1H NMR spectroscopy and Exposed trees that successfully acquired HLB were compared with Control. The citrus leaf metabolome comprised 34 water-soluble metabolites and included 3 sugars, 15 amino acids, and several other metabolites involved in defense and energy metabolism. Differences in the concentration of key metabolites enabled discrimination between infected and healthy plants beginning at 8 weeks post-exposure to ACP and prior to the development of visual HLB-related symptoms. This work demonstrates that NMR-based metabolomics can distinguish citrus plants on the basis of HLB infection status and therefore may be useful as part of an early detection strategy to mitigate the spread of HLB. Research supported by CRB grant 5300-150.

23. Investigation of environmental fate and potential impacts of Thiobencarb application in California rice fields using RICEWQ

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Thiobencarb is a commonly used herbicide at California ice fields. Released paddy water containing thiobencarb may pose potential ecological risks to non-targeted organisms. In this research, RiceWQ model is employed to assess the environmental fate and impacts of thiobencarb in Colusa Basin, northern California. RiceWQ is first equilibrium tested and then calibrated at field level. Different water/pesticide management practices on water use and thiobencarb exposures are compared. With the help of long term thiobencarb application information from California Pesticide Use Reporting (PUR) database, model is extended from one plot to the whole Colusa Rice fields. The temporal/spatial distribution of thiobencarb exposure was evaluated, followed by assessment of ecological impacts on various non-target organisms. Our research indicated that RiceWQ is able to correctly reflect the initial partitioning of thiobencarb in both paddy water and soil phase. The dynamics of thiobencarb is also well captured by model at field level after calibration. Mandatory water holding plays a critical role to reduce thiobencarb exposure in release paddy water. 30-days holding can reduce the thiobencarb concentration by 64%, when compared to 6-days holding practice. The geo-spatial pattern of exposure in the study domain indicates the different extent of pollutant level and its distribution over space. “Risk zones” for different species could be identified based on the geo-spatial pattern of thiobencarb exposure. The same exposure of thiobencarb may impose different level of risks to various non-target species due to the susceptibility differences.

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